

The suspending properties of *Azanza garckeana* pectin in magnesium carbonate suspension

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Abstract

Many natural agents have been employed as suspending agents in pharmaceutical suspension formulations. The need to expand the base of natural suspending agents used in the pharmaceutical industries necessitated this study. The purpose of this work was to produce cheap, available and effective natural excipient to be used as an alternative for the formulation of pharmaceutical suspensions. The suspending properties of *Azanza garckeana* pectin (Malvaceae) was studied in comparison with tragacanth gum and acacia gum at concentrations of 1 to 4% w/v in magnesium carbonate suspension. pH, sedimentation volume, viscosity, redispersibility and flow rate of suspensions were used as parameters for evaluation. It was observed that their suspending ability was in the order of *Azanza garckeana* > tragacanth > acacia. From this study, the higher the concentration of these suspending agents, the higher the pH, sedimentation volume, redispersibility number, viscosity and reverse for the flow rate. The results suggest that *Azanza garckeana* pectin has best suspending properties amongst the investigated natural polymers at all concentration used and thus has good characteristic as a novel suspending agent in pharmaceutical suspensions.

Keywords: *Azanza garckeana* pectin, suspension, sedimentation volume, viscosity, redispersibility

Introduction

Suspension as a liquid dosage form offers a convenient way to administer insoluble or sparingly soluble drugs to paediatric and geriatric patients [1], that have difficulty in swallowing capsules or tablets. One requirement of a suspension is the ability of the dispersed phase to remain in suspension long enough for removal of accurate doses from oral products and also the correct proportion of active ingredients from external preparations. This property could be achieved by addition of a suitable suspending agent in a dispersed system. Suspending agents are substances that spontaneously form colloidal dispersions with water because of the affinity between the dispersion medium and dispersed particles [2]. Natural suspending agents are usually used as they are biocompatible and biodegradable [3]. *Azanza garckeana* is a member of the Malvaceae family and occurs in a wide range of warmer parts of Southern, Eastern and Western Africa. It is a shrub or small tree growing up to 10m tall with stem diameter at breast height of up to 25cm. It can be used for dietary and medicinal purposes [4]. *Azanza garckeana* fruit contains pectin which is a hydrocolloid. The traditional application of pectin is as a jelling agent in jellies and jams and in recent times, pectin has found use not only in food industry, but also in the pharmaceutical industry [5]. It seems that no work has been done on the potentials of *Azanza garckeana* as a suspending agent compared to common natural agents such as acacia and tragacanth. In the current study, the suspending property of *Azanza garckeana* (Ag) pectin is being compared to Tragacanth (Tr) and Acacia gum (Ac) in magnesium carbonate suspension.

Materials and Methods

Materials

The materials used are Magnesium carbonate (Suzhou

biological tech Ltd. China), Acacia powder (S.D. Fine, Mumbai), Tragacanth gum powder (Searl Co, England), Benzoic acid, Amaranth (Chapman) and distilled water. *Azanza garckeana* fruit was purchased from Gombe state in the North Eastern region of Nigeria. All other chemicals were of analytical grade.

Methods

Pectin was obtained by precipitation with ethanol from *Azanza garckeana* fruit by the method reported by [5] with slight modifications. The modifications are as follows: the acidified mixture was heated at 90 °C, the mixture of pectin hydrocolloids with 96% ethano was kept aside for 3 hours to allow the pectin float on the surface, the precipitate was washed 2 times using 80% ethano to remove remaining impurities and the pectin hydrocolloid produced was dried at 40°C in hot air circulating oven for 3 hours.

Preparation of Magnesium Carbonate Suspension

(10% w/v) magnesium carbonate suspension containing 1% w/v of Ag was prepared as follows: 10g of magnesium carbonate powder and 1g of Ag powder were triturated together in a mortar with 20ml of distilled water to form a smooth paste; 2ml of benzoic acid was added as preservative and 1ml of amaranth solution as colorant while distilled water was added slowly with constant stirring. The mixture was transferred into 100ml amber bottle and made up to volume. The mouth of the bottle was covered and shaken vigorously for 2 minutes and kept at room temperature of about 25 °C on a flat surface. The procedure was repeated using 2%, 3% and 4% w/v Ag and 1 to 4% w/v of tragacanth and acacia respectively.

Evaluation of suspension properties

The suspension properties were evaluated for the following:

pH determination

A 2% dispersion of each suspending agent in distilled water was shaken for 5 minutes and the pH of its supernatant was measured in triplicate on a digital pH meter (Shangai Chunye Instrument Technology, China)^[6].

Sedimentation Volume

50ml of each batch of the suspension was poured into a 50ml measuring cylinder and left untouched for seven days at 35 °C. The sedimentation volume of each suspension was taken at every hour for 7 hours and every 24 hours for 7 days. Readings were in triplicates. The sedimentation volume was calculated using this formula:

$$F = V_u/V_o \quad (1)$$

Where V_u is the ultimate volume of the sediment while V_o is the original volume of the suspension.

Redispersibility Test

This was done by rotating the bottle containing the suspension at an angle of 180°. The number of times the bottle was rotated to achieve complete redispersion of each sample was recorded as redispersibility number. The test was carried out in triplicates.

Flow Rate

The time expected for 10mls of each suspension sample to

flow through a 10ml pipette (from a fixed height) was done in triplicates. The flow rate was calculated using the formula:

$$\text{Flow rate } \eta_\alpha = \frac{\text{volume of pipette (ml)}}{\text{Flow time (s)}} \quad (2)$$

Viscosity

The viscosity (in poise) of the samples was determined at 25 °C using the Brookfield Synchro-lectric viscometer. Model LVF (Brookfield Laboratories, Massachusetts) at 60 revolutions per minute (Spindle #4). All the determinations were made in triplicates and results obtained were expressed as mean values.

Statistics: Microsoft Excel 2016 was used. Mean and standard deviation for all the data were computed.

Results and Discussion

pH Determination

The pH values for all the suspending agents studied are presented in Table 1. All the suspending agents utilized in this study exhibited slightly acidic pH, which makes them compatible with active pharmaceutical ingredients that have pH values within this range thus confirming the stability of *Azanza garckeana* pectin in this formulation^[7]. It was also observed that increase in concentration of suspending agents increased the pH value. Fig. 1 showed a comparative pH profile of all the batches.

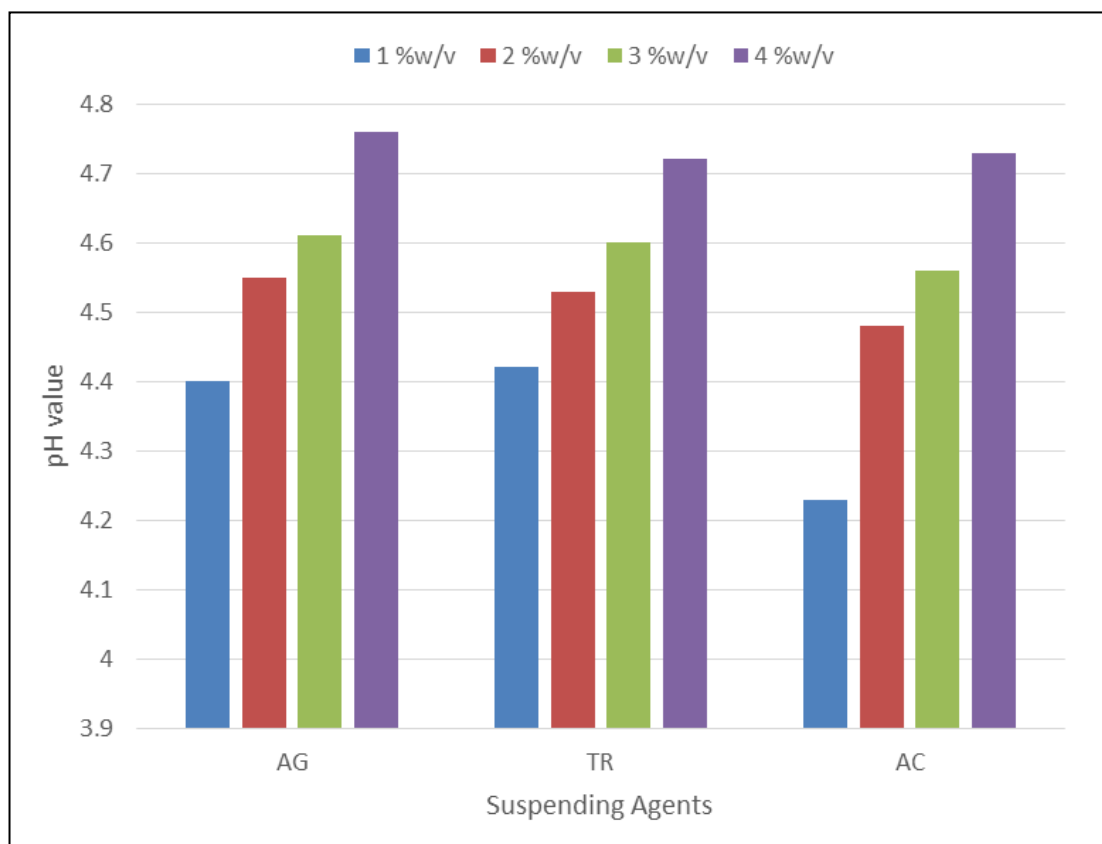


Fig 1: Comparative pH profile for all batches of the Suspension.

Table 1: Rheological properties and pH values of magnesium carbonate suspension formulated with different suspending agents at varying concentrations

Suspending Agents	Concentrations %w/v	Redispersibility Number	Flow rate (ml/sec)	Viscosity at 25 °C (poise)	pH
Azanza garckeana	1	6.01 ± 0.01	1.10 ± 0.01	0.74 ± 0.01	4.40 ± 0.01
	2	8.46 ± 0.02	1.06 ± 0.01	1.16 ± 0.00	4.55 ± 0.01
	3	10.21 ± 0.01	1.04 ± 0.01	1.42 ± 0.00	4.61 ± 0.01
	4	12.31 ± 0.01	1.00 ± 0.01	1.67 ± 0.01	4.76 ± 0.01
Tragacanth	1	5.01 ± 0.02	1.04 ± 0.02	0.61 ± 0.01	4.42 ± 0.01
	2	6.51 ± 0.01	0.97 ± 0.01	1.10 ± 0.01	4.42 ± 0.01
	3	7.43 ± 0.01	0.87 ± 0.01	1.30 ± 0.01	4.60 ± 0.01
	4	8.51 ± 0.01	0.83 ± 0.01	1.60 ± 0.01	4.72 ± 0.01
Acacia	1	4.41 ± 0.01	1.03 ± 0.01	0.51 ± 0.01	4.23 ± 0.01
	2	6.31 ± 0.01	0.94 ± 0.00	1.05 ± 0.01	4.48 ± 0.01
	3	7.54 ± 0.01	0.84 ± 0.01	1.20 ± 0.01	4.56 ± 0.01
	4	8.01 ± 0.01	0.81 ± 0.01	1.45 ± 0.01	4.73 ± 0.01

Values shown are mean ± SD (n = 3)

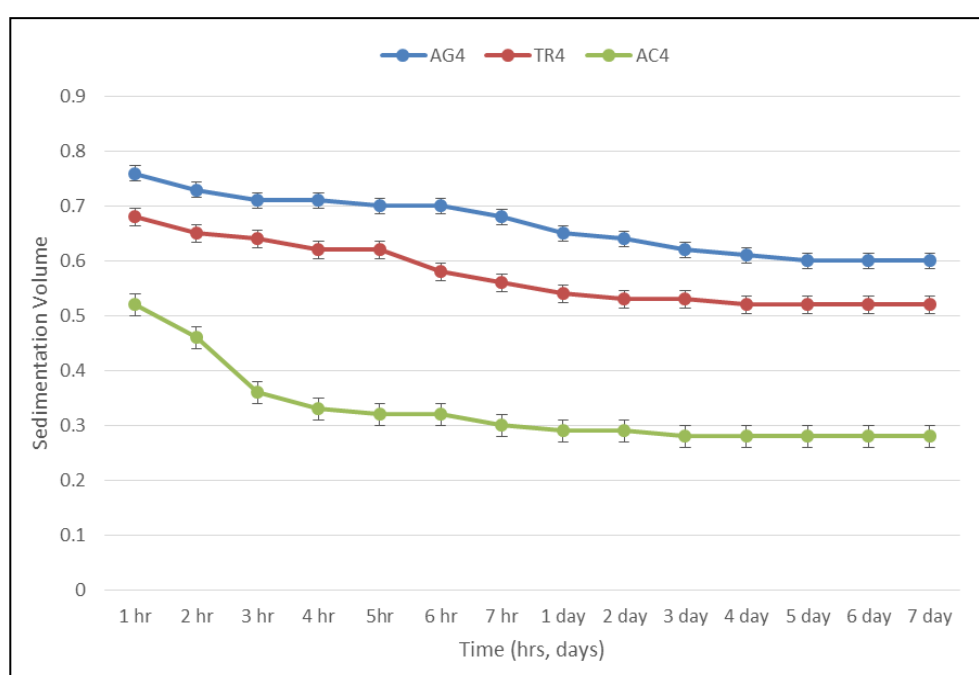
Sedimentation Volume

Sedimentation means settling of particle under gravitational force in liquid dosage forms. Sedimentation volume is the ratio of the height of the sediment after settling and initial height of sedimentation [8]. As presented in Table 2 and in plots of sedimentation volume (Fig. 2), F against time, the values of F for all the formulations were observed to increase as concentration of the suspending agents increased

but remain constant after day 4. The sedimentation volume of Ag pectin did not change significantly over a period of 7 days indicating higher degree of flocculation and good stability of the suspensions [9]. Overall, at all concentrations, suspension formulated using *Azanza garckeana* pectin showed higher values of F than those containing other suspending agents.

Table 2: Sedimentation Volume of magnesium carbonate suspensions containing various concentrations of the suspending agents.

Suspending Agents	Concn. %w/v	Hours							Days							
		0	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Azanza garckeana	1	1.00	0.40	0.38	0.31	0.29	0.28	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18
	2	1.00	0.43	0.40	0.32	0.30	0.30	0.28	0.28	0.26	0.26	0.25	0.25	0.25	0.25	0.25
	3	1.00	0.54	0.51	0.48	0.45	0.44	0.40	0.38	0.35	0.35	0.34	0.34	0.33	0.33	0.33
	4	1.00	0.76	0.73	0.71	0.71	0.70	0.70	0.68	0.65	0.64	0.62	0.61	0.60	0.60	0.60
Tragacanth	1	1.00	0.38	0.35	0.30	0.27	0.26	0.25	0.25	0.24	0.24	0.22	0.22	0.22	0.22	0.22
	2	1.00	0.42	0.40	0.34	0.31	0.29	0.27	0.27	0.26	0.26	0.25	0.24	0.24	0.24	0.24
	3	1.00	0.50	0.46	0.41	0.38	0.36	0.33	0.30	0.29	0.29	0.29	0.28	0.28	0.28	0.28
	4	1.00	0.68	0.65	0.64	0.62	0.62	0.58	0.56	0.54	0.53	0.53	0.52	0.52	0.52	0.52
Acacia	1	1.00	0.27	0.26	0.26	0.25	0.25	0.24	0.24	0.23	0.23	0.22	0.22	0.22	0.22	0.22
	2	1.00	0.35	0.29	0.29	0.28	0.28	0.27	0.26	0.25	0.25	0.24	0.24	0.24	0.24	0.24
	3	1.00	0.49	0.45	0.34	0.32	0.30	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27
	4	1.00	0.52	0.46	0.36	0.33	0.32	0.32	0.30	0.29	0.29	0.28	0.28	0.28	0.28	0.28

**Fig 2:** Plots of sedimentation volume of magnesium carbonate suspension against time (hours and days) at 4% w/v concentration.

Redispersibility

A good suspension should exhibit easy redispersibility (low redispersibility number) so as to ensure uniformity of administered doses of medicament upon shaking ^[10]. All the formulation exhibited low redispersibility number as shown in Table 1.

Flow Rate (F)

The results of flow rate are shown in Table 1. The flow rate of the suspensions was found to decrease as concentration of suspending agents and viscosity of suspension increased. It is found in the range of (0.81 -1.10). Suspending agents increase the viscosity of the formulated suspension and thus it took more time for the suspensions with higher proportion of Ag to flow through the 10ml pipette. Values in Table (1)

showed that as the concentration is increasing, the flow rate of the suspension decreases.

Viscosity Determination

The viscosity of the suspension is of utmost importance for the pourability and stability of the formulation. The optimum concentration of the suspending agent imparting thickening on the suspension has to be identified in order for the stability to be maintained with its dispersibility. In this study, viscosity increase with increase in concentration of the suspending agents as shown in Fig. (3) and Table (1). Interestingly, it was observed that 4%^{w/v} concentration of *Azanza garckeana* pectin gave a stable suspension hence could be used at this concentration as compared to other suspending agents reported in ^[1, 11].

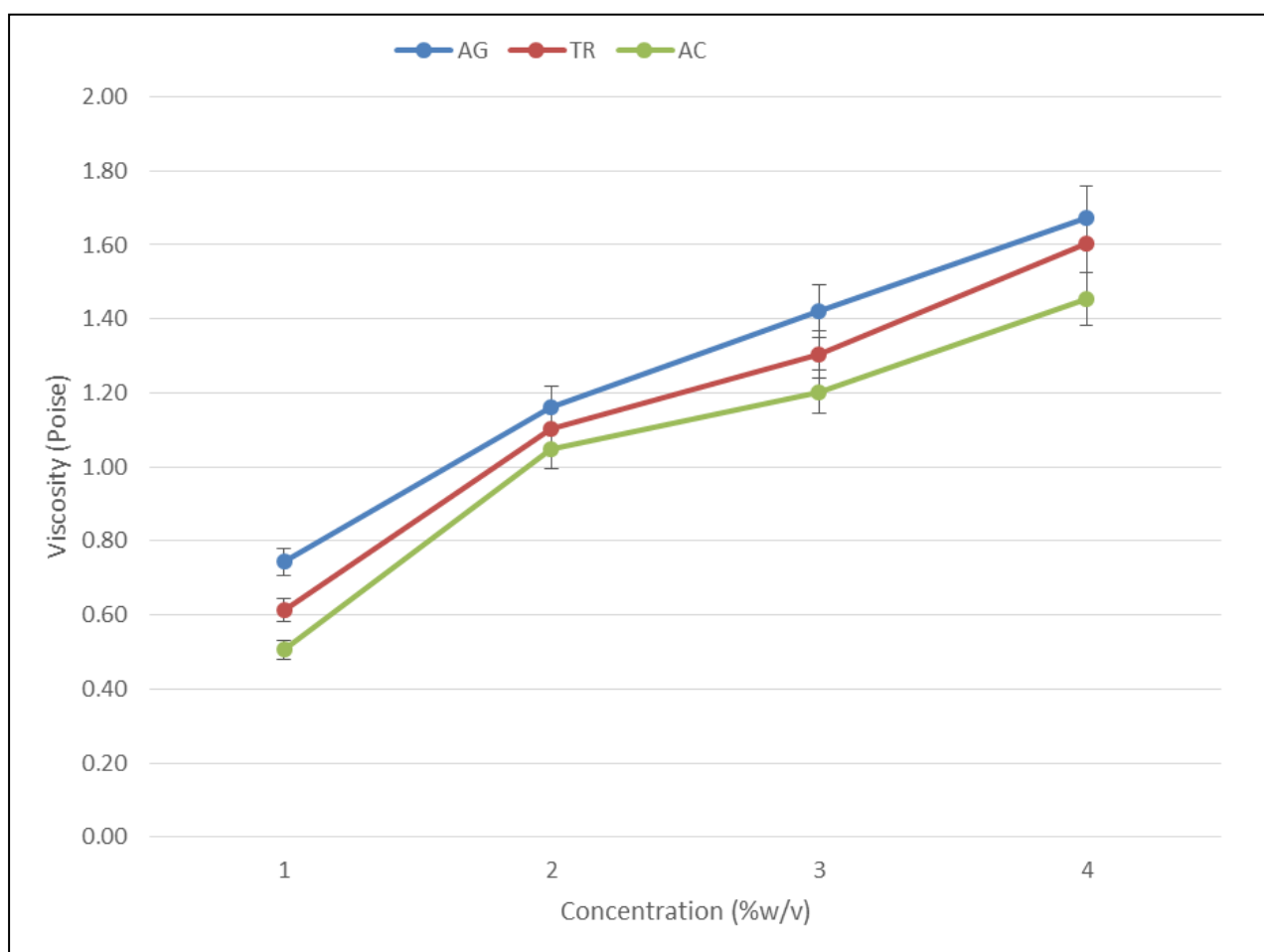


Fig 3: Plots of Viscosity of Magnesium Carbonate suspension against concentration of suspending agents at 25 °C.

Conclusion

In view of these results, *Azanza garckeana* pectin exhibited the best suspending properties when compared to all the other agents employed in the formulations and can be used as an alternative suspending agent in the formulation of pharmaceutical suspensions. Moreover, its high viscosity could be exploited for use as a stabilizer and thickening agent in the food industry.

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