Research Article

Evaluation of *Amaranthus viridis* L. Leave Mucilage as Suspending Agent

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Abstract

The present study was carried out to evaluate the mucilage extracted from *Amaranthus viridis* L. leaves (family: Amaranthaceae) as a new suspending agent. Zinc oxide (20% w/v) suspensions were formulated, where mucilage extracted from *Amaranthus viridis* L. leaves and gum tragacanth were utilized as suspending agents. The formulated suspensions were assessed for sedimentation parameters such as sedimentation volume, degree of flocculation and redispersibility. The results obtained indicated that the extracted *Amaranthus viridis* L. Leave mucilage could be employed as novel and useful suspending agents in pharmaceutical suspensions.

Keywords: Suspensions; pharmaceutical excipients; suspending agents; mucilage; *Amaranthus viridis* L. leaves.

Introduction

Pharmaceutical suspensions are the liquid dosage forms, where finely divided insoluble solid particles are uniformly distributed throughout the continuous phase containing liquid (oily/aqueous) and the system is stabilized using 'suspending agent' [1,2]. Pharmaceutical suspensions may be classified into three major groups: oral suspensions, parenteral suspension, and externally applied suspensions [2]. Suspending agents are the substances which are added to a suspension for the viscosity enhancement of the continuous phase. For this reason, insoluble solid particles remain suspended over a prolonged time and it becomes easy to measure the accurate dose [3]. Majority of the suspending agents imparts viscosity to the solution besides acting as suspending agents. In addition, suspending agents usually form film around the suspended particles and this reduces the inter-particle attraction [1]. An ideal suspension must possess good thixotropy [3]. The viscous nature of suspension is capable of preventing sedimentation as well as aggregation or caking of the particles. The measurement of the content of suspending agent for formulation of suspension is mostly dependent on the other excipients. The suspending agents should have the capacity to contribute viscosity to the medium [2].

Presently, the human civilization is turning towards the searching of effective and useful excipients from natural sources for the potential uses in healthcare [4-6]. The natural excipients possess some potential advantages over the synthetically derived excipients are generously available from natural resources, safe for consumption and inexpensive [4,7,8]. Further natural excipients can be chemically modified to obtain advanced excipients [9,10]. Since ancient era, plant mucilages are being used in many healthcare applications [11-12]. During past few decades, numerous plant mucilages are being used as pharmaceutical excipients in the formulations of both solid and liquid dosage forms [13-20]. These are important category of polysaccharide materials exhibiting their potential uses as pharmaceutical excipients such as binders, thickeners, emulsifiers, suspending agents, disintegrants, gelling agents, mucoadhesives, film-formers, matrix-formers, etc [21-23]. Therefore, the requirement of these plant-based materials (mucilages) as excipients is escalating and new sources for these materials are required to be identified.

Amaranthus viridis L. (family: Amaranthaceae) is an annual herb type plants. These plants are commonly found in India, Bangladesh, Pakistan and South Africa [24,25]. *Amaranthus viridis* L. plant possess terminal panicles together with few branches as well as green flowers [24,26]. Its leaves are ovate, which are 3–6 cm in length and 2–4 cm in width having

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approximately 5 cm long petioles. *Amaranthus viridis* L. leaves are consumed as food vegetable in many countries like India, Bangladesh, Pakistan and South Africa [25]. It is also an excellent source of minerals and antioxidants [27].

Amaranthus viridis L. is also been recognized and utilized as a medicinal herb [28]. It has traditionally been employed in the management of dysentery, hemorrhoids, kidney ailments, etc [29]. This plant is already reported for its antibacterial activity [30]. Its leaf and seed extracts also reported for antimicrobial activity along with antioxidant potential [31]. The antipyretic and antinociceptive properties of *Amaranthus viridis* L. leaves have already been reported [32].

The purpose of the current research was to evaluate an economical and effectual plant originated naturally-derived plant-based excipients, which can be utilized as a potential suspending agent to formulate suspensions. In view of importance of natural suspending agent in pharmacy for the manufacture of suspensions, mucilage extracted from *Amaranthus viridis* L. leaves, commonly named Leotia (belonging to the family: Amaranthaceae) were evaluated comparatively with gum tragacanth (standard suspending agent) at different concentrations (0.5-2% w/v) in 20% w/v zinc oxide suspensions. Therefore, the objectives of the current research were to: extract mucilage from *Amaranthus viridis* L. Leaves, perform phytochemical identification test for confirmation the isolated *Amaranthus viridis* L. leaves mucilage, prepare zinc oxide (20% w/v) suspensions using mucilage extracted from *Amaranthus viridis* L. leaves and gum tragacanth at different concentrations (0.5- 2% w/v) as suspending agents, and evaluate various sedimentation parameters such as sedimentation volume, degree of flocculation, and redispersibility as basis for comparison.

2. Materials and Methods

2.1. Materials

Zinc oxide (E. Merck, India), gum tragacanth (Loba Chemie, India), benzoic acid (SD Fine Chemicals, India), sodium metabisulfite (Qualigens Fine Chemicals, India) and potassium dihydrogen phosphate (Qualigens Fine Chemicals, India) were used in this research work. All other chemicals used in this research were analytical grade. Fresh and healthy leaves of *Amaranthus viridis* L. were collected from the Jharpokharia market of Mayurbhanj District, Odisha, India.

2.2. Extraction of mucilage

Mucilage was extracted from fresh and healthy leaves of *Amaranthus viridis* L. in the laboratory. Leaves were sliced, homogenized with cold water (maintaining raw material to water ratio of 1 : 5) containing sodium metabisulphate (1% w/v). The crude material was then squeezed using a piece of muslin cloth to separate the marc from filtrate content. Extracted mucilage was found to get precipitated from water employing acetone. The precipitated mucilage was then dried for 24 hours at room temperature. The dried mucilage was powdered and passed though sieve number 80. The powdered and dried mucilage extracted from *Amaranthus viridis* L. leaves was stored in a desiccator for further study [14,15].

2.3. Phytochemical identification studies

The extracted *Amaranthus viridis* L. Leaves mucilage was tested for phytochemical identification, which were carried out for the identification of the presence of mucilage (Ruthenium red test), carbohydrates (Molisch's test), starch (Iodine test), glycosides (Keller Killiani test), alkaloids (Dragendroff's test), steroids and sterols (Libermann-Burchard test), tannins (Ferric chloride test), proteins and amino acids (Ninhydrin test) [33].

2.4. Preparation of zinc oxide suspensions

In this work, 20% w/v zinc oxide suspensions were formulated using *Amaranthus viridis* L. leaves mucilage and gum tragacanth at different concentrations (0.5, 1 and 2% w/v). In brief, zinc oxide was first taken and levigated with glycerin in a ratio of 1:1. Then, the accurately measured content of suspending agents (here mucilage extracted from *Amaranthus viridis* L. leaves and gum tragacanth) were added and then triturated. As preservative, benzoic acid (0.1% w/v) was added to the prepared suspensions. The volume of prepared suspensions was made up with distilled water. All the prepared suspensions were deflocculated. The flocculated suspensions were prepared using 0.004 M potassium dihydrogen phosphate as flocculating agent to calculate the degree of flocculation.

2.5. Evaluation of zinc oxide suspension

Sedimentation volume: Sedimentation volume (F) is the ratio of ultimate height (Hu) of sediment as the suspension settles in a cylinder under standard condition to the initial height (Ho) of the total suspension. It was calculated by maintaining a calculated volume of suspensions formulated using mucilage extracted from *Amaranthus viridis* L. leaves and gum

Table 1: The results of phytochemical identification on extracted material from *Amaranthus viridis* L. leaves

Identification tests for	Name of tests	Observations
Mucilages	Ruthenium red test	+
Carbohydrates	Molisch's test	+
Starchs	Iodine test	-
Alkaloids	Dragendroff's test	-
Glycosides	Keller- Killiani test	-
Tannins	Ferric chloride test	-
Steroids and sterols	Libermann-Burchard test	-
Proteins and amino acids	Ninhydrin test	-

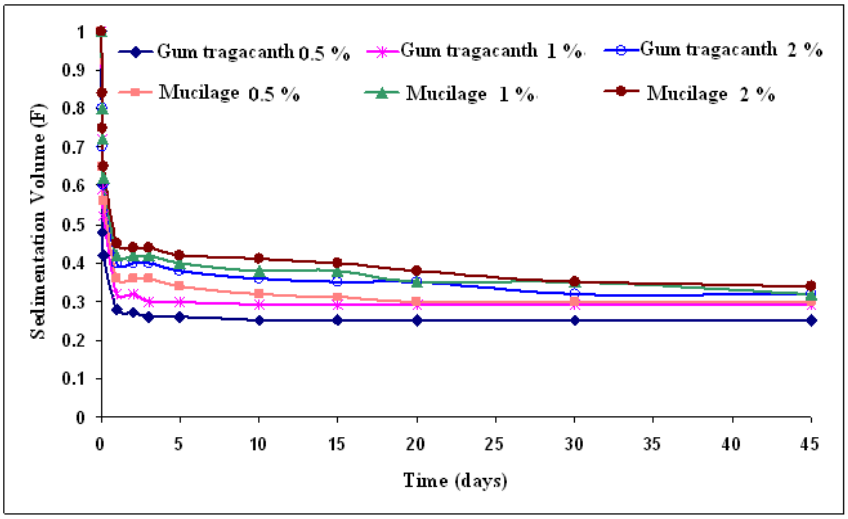

Figure 1: The sedimentation volume (F) profiles of 20% w/v zinc oxide suspensions formulated using extracted *Amaranthus viridis* L. leave mucilage and gum tragacanth as suspending agents

Table 2: Degree of flocculation (β) of various suspending agents

Suspending agents	*Amaranthus viridis* L. leave mucilage			Gum tragacanth		
	0.5 %	1.0 %	2 %	0.5 %	1.0 %	2 %
β^2	2.60 ± 0.05	3.07 ± 0.08	3.18 ± 0.11	2.05 ± 0.04	2.42 ± 0.12	3.12 ± 0.10

tragacanth in graduated cylinders at an undisturbed position for a definite time. The values of Hu and Ho were noted [14,15].

Degree of flocculation: The degree of flocculation (β) values of these suspensions prepared using mucilage extracted from *Amaranthus viridis* L. leaves and gum tragacanth was calculated as: β = (Vu)floc / (Vu)defloc, where (Vu)defloc is the ultimate sedimentation volume in the deflocculated suspensions and (Vu)floc is the ultimate sedimentation volume in the flocculated suspensions [13].

Redispersibility: Different suspensions (50 ml) were taken in calibrated measuring cylinders and these were stored for 1, 5, 7, 10, 14, 21, 25, 30 and 45 days at room temperature. Cylinders were taken at customary interval one by one and vigorously shaken to redisperse the sediment, if any and were recorded [14].

22.6. Statistical analysis:
All measured data was expressed as: mean ± standard deviation (S.D.), n = 3. The calculation was carried out using MedCalc software.

3. Results and discussion

3.1. Extraction and phytochemical identification of mucilage:

The yield of *Amaranthus viridis* L. leaves mucilage extracted from fresh and healthy leaves was 11.28 ± 0.12% w/w.
Different phytochemical identification testings were carried out on the extracted material from *Amaranthus viridis* L. leaves. The phytochemical identification testing results on the extracted material are presented in Table 1. The phytochemical identification tests were performed on extracted *Amaranthus viridis* L. leaves mucilage indicated the presence of both mucilage as well as carbohydrate. The treatment of extracted material with ruthenium red revealed red colouration suggesting that the mucilage was present in the extracted material. A violet-colored ring was identified at the junction of 2-liquids on reaction with Molisch's reagent suggesting the occurance of carbohydrates. The extracted material did not show any purple colouration when treated with Ninhydrin reagent suggesting the absence of amino acids and proteins. From the obtained results, it was revealed that glycosides, alkaloids, tannins, steroids and sterols were absent in the extracted material from *Amaranthus viridis* L. leaves.

3.2. Evaluation of zinc oxide suspension:

Different formulations of suspensions were formulated with zinc oxide (20% w/v) but with varying concentration of *Amaranthus viridis* L. leaves mucilage (0.5-2% w/v) as well as the conventional suspending agent, gum tragacanth. The sedimentation volume (F) of suspensions formulated using *Amaranthus viridis* L. leaves mucilage were compared with suspensions prepared using gum tragacanth (as standard) as suspending agent. The sedimentation volume (F) profile of the 20% w/v zinc oxide suspensions prepared using *Amaranthus viridis* L. leaves mucilage and gum tragacanth as suspending agent are presented in Figure 1. The dispersed insoluble solid particles produced the sediment at a comparatively faster rate in these suspensions prepared using 0.5% w/v of suspending

agents than those of 1% and 2% w/v. The 20% w/v zinc oxide suspensions prepared using *Amaranthus viridis* L. leaves mucilage showed comparatively better results compared that of gum tragacanth.

The degrees of flocculation (β) values were calculated for 20% w/v zinc oxide suspensions using different concentration of extracted *Amaranthus viridis* L. leaves mucilage and gum tragacanth as suspending agents. The degrees of flocculation values are presented in Table 2. According to Martin et al (2001) the sedimentation volume is capable of providing only a qualitative measure of flocculation [3]. The degree of flocculation (β) is important and useful parameter in evaluation of suspension, which is the ratio of ultimate sedimentation volume in the flocculated as well as deflocculated systems. A comparison of degrees of flocculation values of suspensions prepared using *Amaranthus viridis* L. leaves mucilage and gum tragacanth showed a higher values for the first one (Table 3). This observation suggested that the test mucilage (i.e., *Amaranthus viridis* L. leaves mucilage) was comparatively better quality suspending agent than gum tragacanth (a traditionally used suspending agent).

Redispersibility of these formulated 20% w/v zinc oxide suspensions was also studied. Since the suspensions produced the sediment on storage, it should be readily dispersible in order to make sure about the dose uniformity. If sediment remains even after vigorously shaking for specified period, the system is described as caked [34]. All formulated 20% w/v zinc oxide suspensions were easily redispersible, irrespective of their concentrations of suspending agents.

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4. Conclusion:

From the obtained results, it was found that the extracted *Amaranthus viridis* L. leave mucilage exhibited its prospective as a novel suspending agent even at low concentration (0.5% w/v). The present research work was a preliminary stand to designate the aptness of *Amaranthus viridis* L. leave mucilage as a suspending agent. The work can be further extended for evaluation of its suitability as disintegrating agent, gelling agent, binding agent, emulsifying agent and other similar pharmaceutical uses considering the easy availability of the *Amaranthus viridis* L. leaves from the natural sources.

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Conflict of Interest

The authors proclaim no conflict of interest

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