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Preliminary Characterization of Novel Gum Obtained from *Myrianthus arboreus* Leaves as Pharmaceutical Excipient

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Original Research Article

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Abstract: Polymeric materials obtained from plant sources have become very versatile excipients for the formulation of pharmaceutical dosage form especially tablet dosage form. This study was aimed at the preliminary characterization of *Myrianthus arboreus* gum as pharmaceutical excipient. *Myrianthus arboreus* gum was extracted from the dried powdered leaves of *Myrianthus arboreus* plant and characterized based on parameters such as micromeritic properties, phytochemical evaluation, viscosity, loss on drying, solubility, ash value and swelling index. The results obtained from this study showed a yield of gum after extraction of 11.34 % and swelling index of 97.63 % after 48 hours. A 1 % $^{w}/_{v}$ dispersion of gum gave pH and viscosity values of 6.73 and 4,333 mPa·s respectively. *Myrianthus arboreus* gum exhibited fairly good flow properties with angle of repose of 31.65 º, bulk and tapped densities of 0.46 and 0.62 g/ml respectively and Carr's index value of 25.33 %. The gum was found to swell in cold water, soluble in hot water and insoluble in organic solvents. It can be concluded therefore that *Myrianthus arboreus* gum could possibly be used as pharmaceutical excipient for the formulation of liquid and solid dosage forms.

Keywords: *Myrianthus arboreus*, Pharmaceutical excipient, Gum, Dosage forms

INTRODUCTION

Nature has endowed us with a wide range of plant materials to help improve and sustained release the health of all living things either directly or indirectly. Gums obtained from plants are hydrophilic polymers of high molecular weights, generally composed of monosaccharide units joined by glucosidic bonds [1].

They are generally insoluble in oils or organic solvents such as hydrocarbons, ether, or alcohols. Gums are either water soluble or absorb water and swell up or disperse in cold water to give a viscous solution or jelly. On hydrolysis they yield arabinose, galactose, mannose and glucuronic acid [2].

Gums obtained from woody and non-woody plant parts such as bark, seeds, sap, roots, rhizomes, fruit and leaves possess a complex, branched polymeric structure, they exhibit high cohesive and adhesive properties and such properties are widely harnessed in formulation of pharmaceutical dosage forms. The major applications of these polymers are useful as tablets binder, disintegrating agent, emulsifier, suspending agent, thickener, gelling agent, stabilizing agent protective colloids in suspension and sustain agent in tablets. They act as adjuvant in some pharmaceutical formulation [3, 4 and 5].

Natural materials have attracted considerable attention for drug delivery applications due to the fact that they are: biodegradable (degradation under natural or physiological conditions), biocompatible and non-toxic, low cost, environmental-friendly processing, better patient tolerance as well as public acceptance and most gums are obtained from edible sources [6].

However natural gums have a number of disadvantages such as: chance of microbial contamination, batch to batch variation, uncontrolled rate of hydration and reduced viscosity on storage but they can also be modified in different ways to obtain tailor made materials for drug-delivery systems and thus can compete with the available synthetic excipients [2].

The tremendous interest in the use of natural gums could also be as a result of challenges of synthetic polymers which includes: high cost, toxicity, environmental pollution during synthesis, non-renewable sources, side effects, and poor patient compliance [6], acute and chronic adverse effects (skin and eye irritation) observed in workers handling the related substances methyl methacrylate and poly-(methyl methacrylate). [7], irritation of Carbomer dust to the eyes, mucous membranes and respiratory tract necessitating the use of gloves, eye protection and dust respirator during handling [8].

Myrianthus arboreus family Urticaceae is a dioecious tropical tree with enormous leaves reaching 70cm in diameter, with 7 to 9 leaflets up to 50cm long and 25cm across. Commonly known as the soup tree, young leaves are an ingredient of a very popular soup in southeast Nigeria. The leaves are also an ingredient of medicine to treat dysentery and relieve fever in infants, and the leaf stalks are mashed as a poultice for boils. The timber is no good for construction but the bark has various medicinal uses in Nigeria, mainly to expel intestinal parasites [9].

Several researchers have studied the antioxidant activities [10, 11, 12], phytochemical and proximate evaluation [13], glucose uptake stimulatory effects [14], wound healing properties [15, 16, 17], of extracts of leaves, stem bark and root bark of *Myrianthus arboreus*, but no research work has been carried out on the gum extracted from the leaves of *Myrianthus arboreus*. Therefore the aim of this study was to investigate the properties of the gum extracted from *Myrianthus arboreus* leaves and its suitability as pharmaceutical excipient.

MATERIALS AND METHODS

Extraction of *Myrianthus arboreus* gum

The fresh young leaves of *Myrianthus arboreus* were purchased from a local market in Agbor, Delta State. The leaves were sun dried, thereafter milled to reduce size of the leaves. A 100 g sample of the dried leaves was weighed and heated at 60ºC in 1000 ml of distilled water for 4hours and thereafter cooled for 1hour. The concentrated solution was filtered through muslin cloth [18, 19]. The viscous filtrate was precipitated with acetone in a ratio of 1:2 i.e. 500 ml of concentrates to 1000 ml of acetone. The precipitated gum was washed several times with acetone to remove all traces of fat. The gum was dried in hot oven at 40ºC and pulverised. The weight of gum extracted was noted and percentage yield was calculated. The dried gum was stored in air tight container until used.

$$\%\ yield = \frac{W_i}{W} * 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where, W_i = weight of extracted gum, W_i = weight of dried leaf

Evaluation of *Myrianthus arboreus* gum

Physicochemical studies

The isolated gum was subjected to physicochemical tests to ascertain the nature of gum isolated.

Molisch test

A 100 mg weight of dried mucilage powder was mixed with Molisch's reagent followed by the addition of concentrated sulphuric acid (H_2SO_4) on the side of a test tube. Appearance of violet green coloring observed at the junction of the two layers shows the presence of carbohydrates

Alkaloid test

Drops of dilute hydrochloric acid was added to the aqueous filtrate of isolated gum and filtered. Drops of Mayer's reagent were added to the filtrate, appearance of red colour indicates the presence of alkaloid [20].

Tanin test

A 1.0 g weight of dried mucilage powder was placed a beaker and 10 ml of distilled water was added. The mixture was boiled for five minutes. Two drops of 5% Ferric chloride ($FeCl_{3)}$ was then added. Production of a greenish precipitate was an indication of the presence of tannins [21].

Saponin test

2ml of water was added to 2ml of aqueous filtrate of the isolated gum and shaken vigorously and observed for persistent frothing.

Solubility studies

Solubility was determined by shaking the powdered mucilage in different solvents such as acetone, chloroform, ethanol, 0.1N HCl, hot water, cold water and glycerin [22].

pH determination

A 1g weight of the extracted gum was made into mucilage by dissolving in 100ml of water. The pH meter (Fisher Scientific inc.UK) was placed into the mucilage and the pH was recorded.

Swelling index

The swelling index of the gum was determined by accurately weighing 1g of gum which was introduced into 25ml measuring cylinder. 25ml of distilled water was added and the mixture was shaken thoroughly every 10 minutes for 1hour and allowed to stand at room temperature for 4hours, 24hours and 48hours. The swelling index was calculated at the different times using the equation below [18].

$$Swelling\ index = \frac{Final\ volume - initial\ volume}{Final\ volume} * 100 \ldots\ldots\ldots\ldots\ldots 2$$

Loss on drying

1g of extracted gum was weighed accurately in a weighing bottle and was dried in a hot air oven at 105 ºC and reweighed at 10minutes intervals until a constant weight was obtained. The percentage of weight loss by the gum was calculated using the equation below.

$$Loss\ on\ drying = \frac{initial\ weight - final\ weight}{initial\ weight} * 100 \ldots\ldots\ldots\ldots 3$$

Viscosity

A 1 g weight of the extracted gum was made into mucilage using 100ml distilled water resulting in 1% $^{w}/_{v}$ dispersion and the viscosity was determined using a rotational viscometer (NDJ – 1, China).

Ash value

Total ash

A quantity of gum equivalent to 2g was weighed and transferred into a preheated porcelain dish and heated at 500 ºC in a furnace for 10 minutes, the porcelain dish was cooled and the ash was weighed.

$$Total\ ash\ value = \frac{weight\ of\ ash}{weight\ of\ polymer} * 100 \ldots\ldots\ldots\ldots\ldots\ldots 4$$

Acid insoluble ash

A volume equivalent to 25ml of dilute acid was added to the total ash and heated for 5 minutes, thereafter filtered and residue was heated and reweighed.

$$Acid\ insoluble\ ash = \frac{weight\ of\ insooluble\ ash}{weight\ of\ dried\ powder} * 100 \ldots\ldots\ldots\ldots\ldots 5$$

Water soluble ash

A volume equivalent to 25ml of water was added to total ash and heated for 5 minute and thereafter filtered and residue was heated and reweighed.

$$Water\ soluble\ ash = \frac{weight\ of\ water\ soluble\ ash}{weight\ of\ dried\ powder} * 100 \ldots\ldots\ldots 6$$

Flow properties of gum

Bulk density

A 10 gram quantity of the gum was weighed and transferring into a 50ml measuring cylinder and the bulk volume was recorded and bulk density was determined using Equation (7)

$$Bulk\ density = \frac{Mass\ of\ powder\ (g)}{Bulk\ volume\ (ml)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 7$$

Tapped density

A 10g quantity of gum was weighed into a measuring cylinder and was tapped for 100 times and the volume was recorded and computed using Equation (8)

$$Tapped\ density = \frac{Mass\ of\ powder\ (g)}{Tapped\ volume\ (ml)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 8$$

Angle of repose

Angle of repose was determined by fixed height funnel method. The height (h) of the heap formed was measured and the diameter (d) of the cone base was also measured and calculated using the equation below [18].

$$Angle\ of\ repose\ (\theta) = tan^{-1}\left(\frac{h}{r}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

Where, h = height of the pile, r = radius of the base of the pile, θ = angle of repose.

Carr's index and Hausner's ratio

Both parameters were calculated using equations 10 and 11 below [23].

$$Carr's\ index = \frac{Tapped - Bulk\ density}{Tapped\ density} * 100 \ldots\ldots\ldots\ldots 10$$

$$Hausner = \frac{Tapped\ density}{Bulk\ density} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 11$$

RESULTS AND DISCUSSION

Physicochemical characterization of *Myrianthus arboreus gum*

The results of the physicochemical characterization of the extracted *Myrianthus arboreus gum* are presented in Table 1. The percentage yield of the gum after extraction and precipitation was 11.34 % which indicates poor yield, the pH of 1 % $^{w}/_{v}$ of the gum was 6.73 which indicates that the gum is slightly acidic and possibly non-irritating to the mucous membrane and may have good biocompatibility [24].

The result for loss on drying was 16.67% ± 0.577; this indicates that the gum is highly hygroscopic in nature and there may be need to store in air tight container [19]. The viscosity of 1 % $^{w}/_{v}$ of the gum was 4,333 mPa·s as such this gum can possibly be used as a viscosity enhancer. The total ash value was 11.37 ± 0.058, while the acid insoluble ash and water soluble ash were 3.94 and 6.0 respectively. High ash value is indicative of contamination, substitution, adulteration or carelessness in preparing crude drug.

Table 1: Some physicochemical properties of *Myrianthus arboreus gum*

Parameters	Results
Percentage yield (%)	11.34
pH	6.73
Loss on drying (%)	16.67 ± 0.577
Viscosity (mPa·s)	4,333
Total ash (%)	11.37 ± 0.058
Acid insoluble ash (%)	3.94
Water soluble ash (%)	6

Micromeritic properties of *Myrianthus arboreus gum*

The values for the different micromeritic parameters which are a measure of the flow properties of powders are presented in table 2. The mean angle of repose was 31.65 ± 1.311 while the mean bulk and tapped densities were 0.46 ± 0.000 and 0.62 ± 0.0230 respectively. The relatively close bulk and tapped density values are reflected in the compressibility index and the Hausner ratio values of 25.33 and 1.34 respectively which are indicative of passable flow properties of *Myrianthus arboreus* gum.

Table 2: Micromeritic properties of *Myrianthus arboreus gum*

Parameters	Results
Angle of repose (º)	31.65 ± 1.311
Bulk density (g/ml)	0.46 ± 0.000
Tapped density (g/ml)	0.62 ± 0.0230
Hausner ratio	1.34 ± 0.052
Carr's index (%)	25.33 ± 2.887

Swelling Index

Swelling index of gum at 4 hours, 24 hours and 48 hours were 78 ± 5.543, 86.77 ± 1.848 and 97.63 ± 1.617 respectively as presented in Table 3, showing good hydration and water uptake capacities and this property may be employed in formulating controlled drug delivery.

Table 3: Swelling index of *Myrianthus arboreus gum*

Time (hour)	Swelling Index (%)
4	78.20 ± 5.543
24	86.77 ± 1.848
48	87.63 ± 1.617

Qualitative phytochemical analysis of *Myrianthus arboreus gum*

Phytochemical test on the gum revealed the presence of Saponin, alkaloid and carbohydrate but tannin was not present in the extracted gum.

Table 4: Phytochemical analysis of *Myrianthus arboreus gum*

Phytochemical test	Result
Tanin	-
Saponin	+
Alkaloid	+
Carbohydrate (Molisch test)	+
+ means present, - means absent	

Solubility

The result of solubility test is shown in Table 5, the gum was found to be soluble in warm water, swells in cold water but insoluble in ethanol, glycerin, chloroform, 0.1N HCl and acetone.

Table 5: Solubility test on *Myrianthus arboreus gum*

Solvent	Solubility
Hot water	Soluble
Cold water	Swells
Acetone	Not soluble
Ethanol	Not soluble
0.1N HCl	Not soluble
Chloroform	Not soluble

CONCLUSION

The parameters evaluated in this study showed that *Myrianthus arboreus* gum have acceptable pH, fairly good flow properties which can be improved as well as favourable physicochemical properties. It can be concluded therefore that *Myrianthus arboreus* gum could possibly be used as pharmaceutical excipient in the formulation of pharmaceutical suspensions as well as solid oral dosage forms.

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