SHORT COMMUNICATION

Physicochemical and analytical evaluation of *Moringa* gum

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ABSTRACT

Moringaoleifera (commonly referred to as the drumstick tree) is probably one of the most well-known trees in terms of medicinal and nutritional value. The Moringa gum is of interest as pharmaceutical excipient, based on its physicochemical properties and biocompatibility among the different components. The present research article aims to evaluate comprehensively some Physicochemical and analytical properties of Moringa gum, giving insight into its possible pharmaceutical applications. Research on Gum Organoleptic Properties and Features. This study examines the characterization of Moringaoleifera gum as a natural polymer. Moringa gum was extracted and purified according to standard protocols, followed by detailed physicochemical and thermal analyses. The gum was evaluated by using Fourier Transform Infrared Spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC) Scanning electron microscopy (SEM), Thermal analysis and UV-spectrophotometric study. These results indicate that Moringa oleifera gum holds potential as a natural polymer for designing sustained release drug delivery systems.

Keywords: Analytical characterization, *Moringa* gum, natural gum, natural polysaccharides, physicochemical properties.

Moringa gum (MOG) is a hydrophilic exudate obtained from the stem of the *Moringa oleifera* tree (Singh *et al.*, 2021). Initially, the gum appears white, but it gradually turns reddish brown with prolonged exposure. *Moringa oleifera* belongs to family Moringaceae is indigenous to India. The plant is primarily grown for its leaves and seed pods, which are utilized in traditional medicine and as vegetables. The study explored the hypoglycemic potential of *Moringa oleifera* flower extract through *in vivo* and *in silico* approaches (Karim *et al.*, 2025). The plant gum exudes through injury or cut to plant stem that have formed typically within an inner secondary cortex of the cork cambium of the bark (Gupta *et al*., 2020). This gum ultimately solidifies and emerges from the bark in shapes resembling teardrops or stalactites when it comes into contact with the environment

Various experiments were conducted as per rules and regulations. Gum from *Moringa oleifera* was harvested. The exudates of *Moringa oleifera* were extracted from the wounds of the trees located in Gwalior, Madhya Pradesh. After complete drying, the collected gums were crushed and sieved through mesh number 80 before being stored in an airtight container. The powdered gums

were subsequently utilized for further research and analysis.

The organoleptic characteristics, such as color, flavor, aroma, and taste, were evaluated as per Umamaheshwari *et al.* (2021), pH was evaluated as per Kannan *et al*. (2025). Solubility, swelling index, loss on drying and ash value was determine as per Rongpipi *et al.* (2023)**.** Specific gravity (SG)**,** was measured in room temperature by using a SG bottle as per the procedure given by Yaumi *et al*. (2016). Water holding capacity evaluated as per Karaman *et al.* (2014), Bulk and tapping density, Angle of repose (Tan θ), Hausners index, Compressibility index (C%) are evaluated as per Hesse *et al.* (2021). Viscosity was evaluated as per Bal *et al.* (2020).

The morphological characteristics of MOG powder were analyzed utilizing a scanning electron microscope (ZEISS, EVO 18, China). The samples were analyzed as per Parlayici and Aras (2024.). A differential scanning calorimeter (Q10, TA Instruments, USA) was employed to conduct a differential scanning calorimetric analysis of MOG. The samples were analyzed as per Desoky *et al*. (2024) and Cuthbertson *et al.* (2024.) FTIR spectroscopy, utilizing Agilent technology, was employed to determine the functional groups the samples were analyzed as per Circelli *et al.* (2024) and Campanale *et al*. (2023.). An X-ray diffractometer (Miniflex 2, Rigaku, Japan) was employed to record the powder X-ray diffractograms of MOG the samples were analyzed as per Tamboli *et al.* (2024) and Son *et al.* (2020). The differential thermal analysis (DTA) and thermogravimetric analysis (TGA) of MOG was determined by Shimadzu (DTG-60H thermogravimeter) japan. The samples were analyzed as Desoky *et al.* (2024) and Cuthbertson *et al.* (2024.). The refined polysaccharide was dissolved in distilled water, enabling the use of UV-Vis analysis (Shimadzu UV-1800, Japan) for the characterization of the material (Shobana *et al*., 2022).

Scanning electron micrograph of *Moringa* gum has been given in Fig. 1. Analysis of the electron micrographs demonstrates that the *Moringa* gum particles are characterized by a polyhedral configuration (Rimpy *et al*., 2017). Moreover, the micrographs reveal the presence of surface cracks and pores in *Moringa* gum, along with a two-layered morphology typical of pure *Moringa*. It is noteworthy that the finely milled gum powder (purified) exhibits a considerably larger size. In terms of nanomaterials, this size range is deemed ideal (Ghosh *et al.,* 2021).

Differential scanning calorimetry (DSC) assesses heat absorption or release in relation to temperature, reflecting physical or chemical transformations within the sample (Fig. 2). The presence of an endothermic peak typically indicates the loss of water content from the compound. The DSC thermogram reveals that the glass transition occurs at 39.22°C, which is influenced by the material's intrinsic characteristics such as its structure, bonding, and molecular weight. Additionally, the endothermic peak for the polymer is observed at approximately 223°C, which is referred to as the enthalpy of transitions and is associated with the crystallinity of the material (Ranot *et al*., 2022).

In Figure 3 illustrates the FTIR spectra of MOG. The broad absorption band observed at 3391 cm^{-1} is attributed to the stretching of –OH groups. The peak at 1611 cm^{-1} corresponds to the C=O stretching of acetyl, while the peaks at 2928 cm^{-1} are likely associated with –CH stretching. Additionally, the peaks at 1516 cm^{-1} and 1438 cm^{-1} can be linked to the C=O stretching of the carboxylic acid in glucuronic acid. Furthermore, the peak at 1285 cm^{-1} may be attributed to –C-OH. MOG also exhibited bands characteristic of carbohydrates within the range of 1000–1200 cm^{-1} (Rimpy *et al*., 2017).

The diffractogram (Fig. 4) confirmed the amorphous characteristics of gum powder, as it exhibited no clear diffraction pattern, unlike the X-ray diffraction pattern of MOG. The X-ray diffraction spectra of MOG powder revealed an absence of identifiable diffraction peaks at (2θ) (Rimpy *et al*., 2017).

Thermal curves for enthalpy obtained through Differential Thermal Analysis (DTA) and mass changes measured by Thermogravimetric Analysis (TGA). The thermograms of the MOG samples are presented in Figure 5. In the case of pure MOG gum, a significant degradation was observed between 228°C and 324°C, resulting in a weight loss of 49%, indicative of polysaccharide decomposition. The TGA results for crude gum revealed a multistage degradation process, with an initial mass loss of 8% commencing at approximately 65°C, as illustrated in Figure 5A. The thermogram pattern of the compound indicated that no intermediates were likely formed during the decomposition process. A notable weight reduction of 49% occurred within the temperature range of 228°C to 324°C (Irfan *et al*., 2021).

The DTG curve indicated the precise temperatures at which exothermic and endothermic processes took place, specifically at 102.60 °C and 116.26 °C, respectively. This observation may provide insight into the degradation observed during the second stage (Fig. 5C). The absence of significant additional peaks in the first derivative curve implies that moisture loss may solely account for the subsequent weight reduction. The differential thermogram (DTA) revealed two distinct endothermic peaks and three exothermic peaks, which included two weak and one broad peak, as illustrated in the energy change (ΔμV) (Fig. 5C). The initial exothermic peak began to appear concurrently with the conclusion of the second endothermic peak, correlating with the weight loss noted in stage III (refer to Fig. 5C) (Irfan *et al.*, 2021).

DTA a significant and robust peak was observed in the thermograms of MOG, indicating an endothermic transition occurring at approximately 100 °C, followed by an exothermic transition in the range of 500 to 600 °C (Fig. 5B). In contrast, gum exhibited less pronounced endothermic and exothermic transitions at 100 to 300 °C and 500 to 600 °C, respectively (Fig. 5B). The degradation patterns of different gum polysaccharides vary due to their distinct structural and functional characteristics (Irfan *et al*., 2021).

UV-Vis spectrophotometry is a vital instrument in analytical chemistry. The observed absorption behavior is a result of "surface plasmon resonance," which is induced by the electromagnetic field. This method highlights the absorption characteristics of MOG, whereas the gum sample does not exhibit any peaks, as demonstrated in (Fig. 6).

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: Result observation of different characteristics of *Moringa* Gum

S. No.	Characteristics		Observation	Remarks
01	Color		Brownish black	----------
02	Odour		Characteristic	----------
03	Taste		Mucilageneous	----------
04	Smell		Characteristic	----------
05	Flavor		Characteristic	----------
06	Solubility		Sparingly soluble in water, practically insoluble in acetone, alcohol, chloroform and ether	Formed a viscous solution in water
07	pH		5.9 ±052	----------
08	Swelling %	Water	94±058	----------
		0.1N Hcl (1.2 pH)	85±0.45	
		Buffer (6.8pH)	94±0.37	
09	Loss on drying %		11.34±0.54	----------
10	Total ash% W/W		2.6±0.27	----------
11	Acid insoluble ash %W/W		0.56±0.29	----------
12	Melting point ^{0}C		57±2	----------
13	Specific gravity g/ml		0.979±0.03	(0.5% W/V)
14	Water holding capacity g		19±0.24	Per 100 g Gum
15	Water content %		1.50±0.06	(KF titration)
16	Pour density g/ml		0.72±0.07	----------
17	Tapped density g/ml		0.87±0.21	----------
18	Angle of repose ^{0}		30±0.04	Excellent
19	Hausner ratio		1.21±0.24	Fair
20	Cars index		17.24±0.18	Fair
21	Heat		No visual change	40^{0}C
22	Light		No visual change	Sun light
23	Humidity		Aggregation of gum in to lumps	----------
24	Particle size µ		32±1.11	----------
25	Viscosity	%W/V	Viscosity (CPS)	----------
		0.1	1.44±0.03	
		0.2	2.37±0.02	
		0.3	3.54±0.07	
		0.4	4.79±0.07	
		0.5	9.73±0.04	

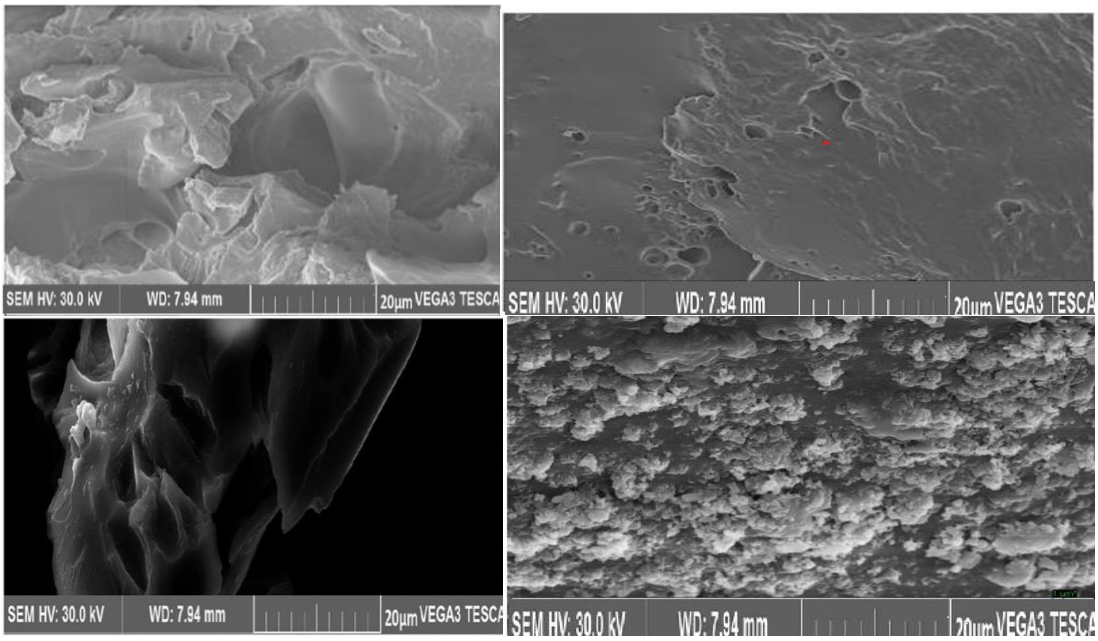

Fig. 1: SEM Study of *Moringa* Gum

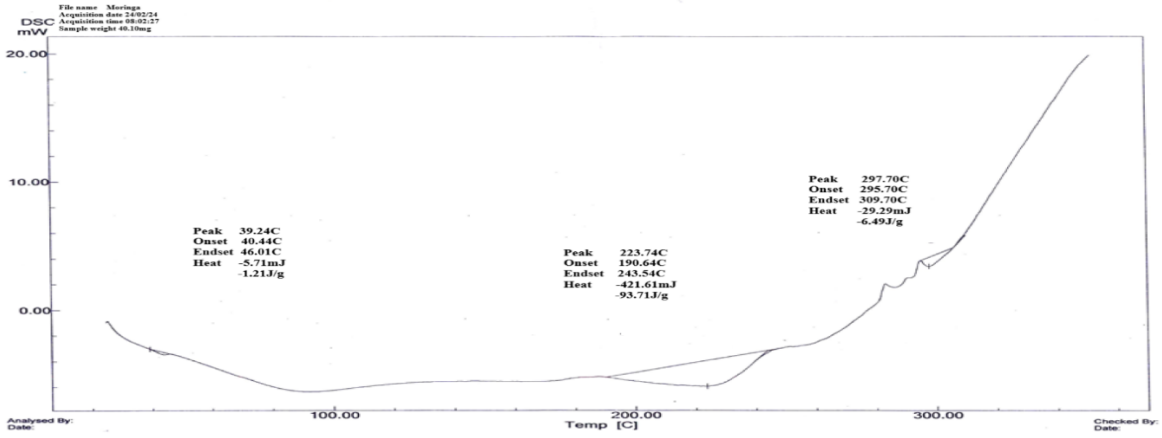

Fig. 2: DSC Study of *Moringa* Gum

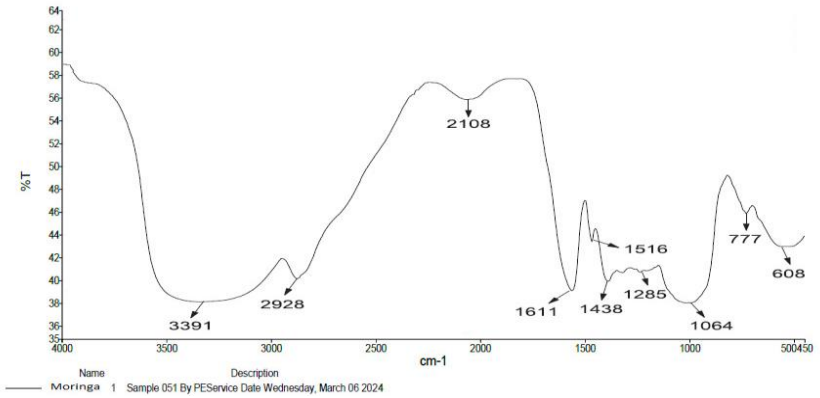

Fig. 3: FTIR Study of *Moringa* Gum

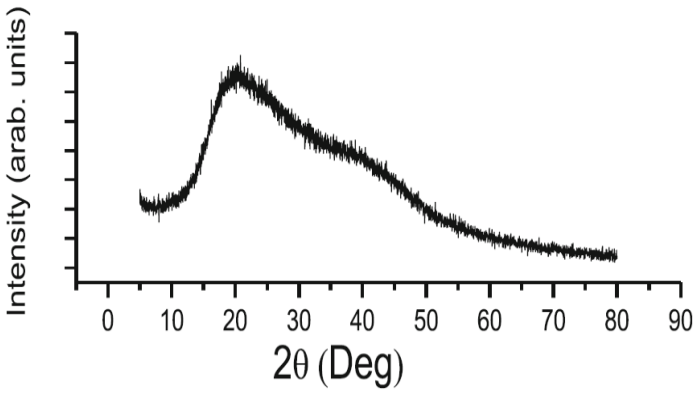

Fig. 4: X-Ray Study of *Moringa* Gum

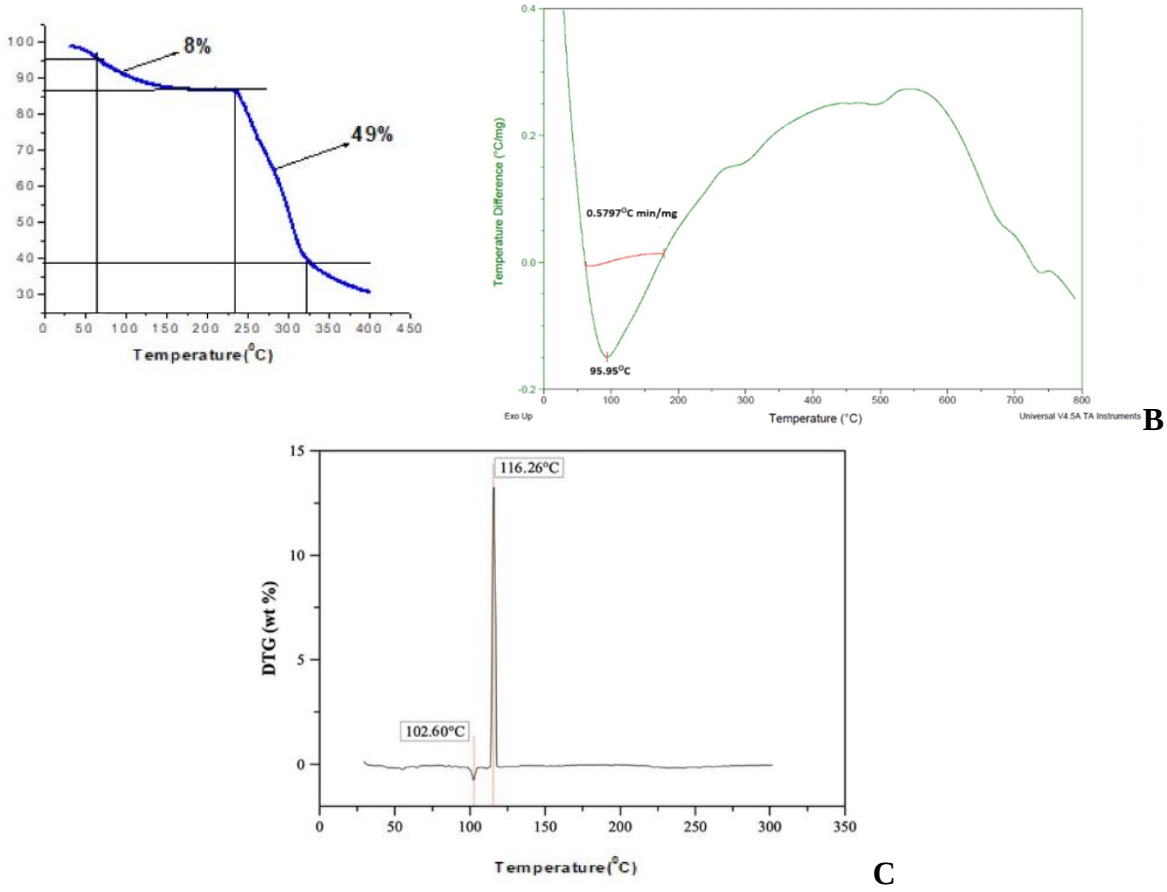

Fig. 5: Thermal Study of *Moringa* Gum

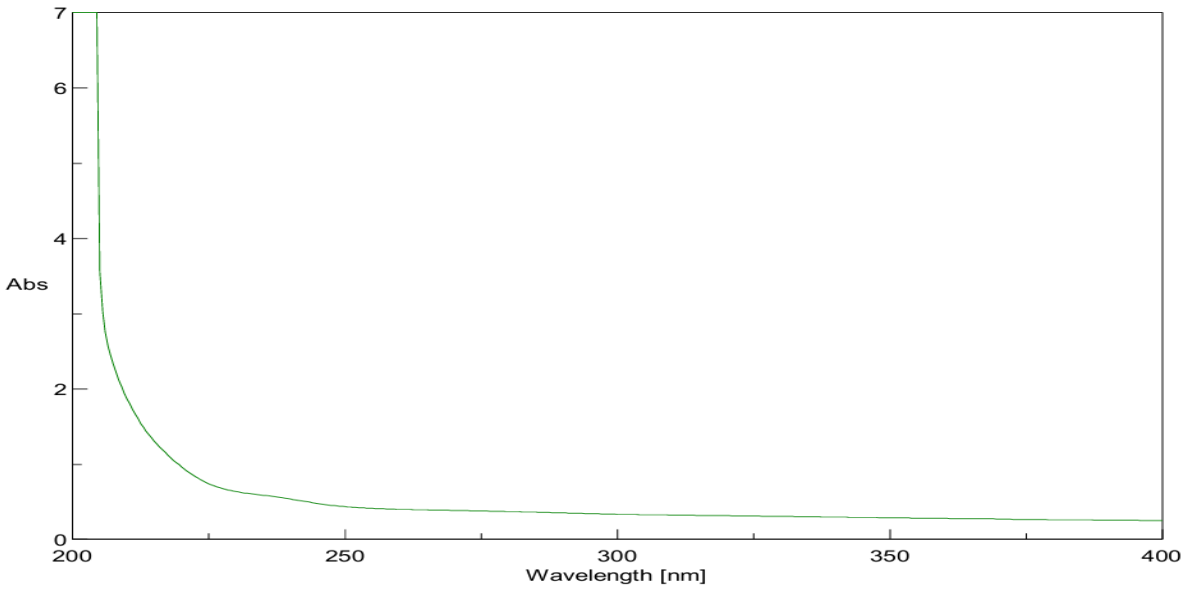

Fig. 6: UV Absorption Study of *Moringa* Gum