



**COMPARATIVE EVALUATION OF THE EMULSIFYING PROPERTIES OF THE
LEAVES OF *CORCHORUS OLITORIUS L.* AND *SESAMUM RADIATUM L.*
MUCILAGES**

***¹Mshelia S. M., ¹Lisiyas S., ²Abdulaziz U.**

¹Department of Pharmaceutics and Pharmaceutical Technology, Faculty of Pharmacy, University of Maiduguri, Borno State

¹Gombe State College of Health Science and Technology Kaltungo

²Department of Pharmaceutics and Pharmaceutical Technology, Faculty of Pharmacy, University of Maiduguri, Borno State

Corresponding author email:suleimanmshelia@unimaid.edu.ng;+2348039280238

Abstract

*This study presents a comparative evaluation of the emulsifying properties of mucilage extracted from *Corchorus olitorius L.* (COM) and *Sesamum radiatum L.* (SRM) as sustainable, natural alternatives to the standard pharmaceutical emulsifier, acacia gum (SAG). The research was driven by the need to identify locally available, cost-effective, and biocompatible excipients to replace imported and synthetic agents. Mucilages were successfully extracted from the leaves of both plants using an aqueous extraction and acetone precipitation method, yielding 10% for COM and 9.5% for SRM. Physicochemical characterization revealed that both mucilages possess favourable properties for pharmaceutical use. COM and SRM exhibited superior swelling capacities (78.34% and 78.11%, respectively) compared to acacia gum (15.76%), and excellent powder flow properties. Oil-in-water (O/W) emulsions were formulated using castor oil and evaluated for stability. Emulsions stabilized with COM demonstrated exceptional long-term kinetic stability, with a creaming index of only 45% after 504 hours, significantly lower than SRM (72%) and the acacia gum standard (75%). Furthermore, COM-stabilized emulsions exhibited desirable shear-thinning behaviour and higher viscosity at optimal concentrations. The findings conclusively position *Corchorus olitorius* mucilage as a highly effective, stable, and viable natural emulsifier, outperforming both *Sesamum radiatum L.* mucilage and the standard acacia gum in key parameters. This research validates the potential of utilizing indigenous plant resources to develop sustainable pharmaceutical formulations, offering a practical solution to reduce dependency on imported excipients, lower production costs, and enhance formulation biocompatibility, particularly in resource-limited settings.*

Key Words: emulsifying properties, mucilage, *Corchorus olitorius*, *Sesamum radiatum L.*, dye solubility.

1.0 Introduction

Pharmaceutical emulsions now represent a sophisticated approach to formulating active pharmaceutical ingredients (APIs) in a biphasic system to enhance their therapeutic

performance (Yandrapalli, 2024). The transition from simple oral mixtures to complex, stabilized systems like parenteral nutrition emulsions and targeted nano

emulsions for oncology illustrates the immense progress in the field (Hörmann & Zimmer, 2016). Modern pharmaceutical development heavily relies on emulsion technology to address issues of drug solubility, stability, bioavailability, and patient-centric dosing (Ahmed et al., 2024). The ability to precisely control droplet size, surface characteristics, and release kinetics has established emulsions as a versatile platform for delivering a wide array of therapeutic agents, from small molecules to large biologics (Anselmo et al., 2019). Due to the inherent immiscibility of the two phases, usually oil and water, emulsions are thermodynamically unstable systems. They possess a high interfacial free energy and will naturally tend to separate over time to minimize this energy, a process driven by the reduction of the total interfacial area between the two liquids (Esquena, 2016). Despite the fact that emulsion could be thermodynamically unstable, prone to creaming, coalescence, cracking, complex to formulate and scale-up (H. Ma et al., 2023), aqueous phase prone to microbial contamination, it offers the advantage of enhance bioavailability of lipophilic drugs, Mask unpleasant taste/odour (Ahmed et al., 2024), can be used via multiple routes: oral, parenteral, topical, ophthalmic, nasal , and Protect labile drugs from degradation (Singh Malik et al., 2016). The wide varying of pharmaceutical applications of mucilages including their non-toxicity, low-cost, high-water swell ability and ready availability a good water-soluble polysaccharide that can be commonly used as additives in manufacturing different dosage forms and other wide range of pharmaceutical dosage

forms (Nagaraja et al., 2021). Mucilages are hydrophilic in nature, they form a dispersion when they come in contact with water, thus increasing the dispersion of the continuous phase, thus allowing solid particle to remain in suspension in the continuous phase and allowing solid particles to remain suspended (Tosif et al., 2021).

Corchorus olitorius Linn. Popularly known as Jute is an annual herb with slender stems. It is mainly used as a leafy vegetable in many tropical areas in tropical Asia in such countries as the Philippines and Malaysia, as well as in tropical Africa, Japan, South America, the Caribbean and Cyprus (Abdel-Razek et al., 2022). In West African countries particularly in Nigeria, Ghana and Sierra Leone, it is also employed as leafy vegetables and used to complement staple foods (Adebo et al., 2018). It is used as an herbal remedy for disease conditions like fevers, chronic cystitis, dysentery and aches. The leaf decoction is used for the treatment of iron deficiency as well as folic acid deficiency, the leaf is also used in the treatment of ascites, dysuria, pectoral pain and female infertility (Shady et al., 2022). The leaf twigs can be used to treat heart issues. In Tanzania, the leaves are used to alleviate constipation. Additionally, leaves are employed as emollient, diuretic and in treatment of infantile malnutrition in Benin (Adebo et al., 2018)

Sesamum radiatum L. is commonly called benniseed in English, karkashi in Hausa. It is available and grows wild in Africa, most especially West Africa. The leaves of this vegetable are alternate positions in the aerial part of the plant. *Sesamum radiatum* L. is

grown in small quantity in the rural areas” (Eromosele et al., 2025). The fresh leaves of *Sesamum radiatum* L. and young stem, cooked and use for soups or sauces, which are eaten with porridge (Bedigian, 2018).

Due to increasing demand on acacia and other natural gums, there is need to search for newer and readily available sources of natural bio-materials that are cost-effective (Hemalatha et al., 2024). This study is aimed at investigating the emulsifying properties of *Corchorus olitorius* leaf mucilage in the formulation of paracetamol emulsion in comparison with a commercial emulsifying agent, acacia BP.

2.0 Materials and Method

Collection and Identification

Fresh leaves of *Corchorus olitorius* and *Sesamum radiatum* L. were bought from Gamboru market in Maiduguri, Borno State. The samples were authenticated in the Department of Pharmacognosy, Faculty of Pharmacy, University of Maiduguri, and assigned voucher numbers UMM/FPH/MAV/012 and UMM/FPH/PEL/001, respectively.

Isolation of Mucilage from the leaves of *Corchorus olitorius* and *Sesamum radiatum* L.

The method described by (Mondal & Tazib Rahaman, 2018a) was adopted with minor modifications. The leaves were shade-dried for seven days, pulverized into fine powder, and weighed. About 2000 g of each powdered leaf sample was soaked in distilled water at a ratio of 1 g to 10 mL (1:10 w/v). The mixtures were heated at 50 °C for 1 hour to allow

dissolution of the mucilage, after which they were cooled and filtered through two layers of muslin cloth to remove debris and fibrous materials. The filtrates obtained were treated with acetone (3.5 %) in a 1:2 ratio (gum solution to acetone) to precipitate the gum. The mixtures were left undisturbed for two hours to complete precipitation. The precipitated gums were separated by filtration, spread as thin layers on stainless steel trays, and air-dried at room temperature (25–30 °C) for 48 hours. The dried gums were milled and sieved using a mesh size of 16 µm, yielding the fine *Corchorus olitorius* mucilage (COM) and *Sesamum radiatum* L. Mucilage powder (SRM) for subsequent analyses.

Determination of Percentage Yield

This was calculated as the ratio of the weight of the dried gum and the weight of the dried leaves, mathematically expressed as thus:

$$\text{Percentage yield} = \frac{\text{weight of the dried gum}}{\text{weight of the dried leaves}} \times 100\%$$

..... Equation 1

Characterization of Mucilage

Organoleptic Properties

The colour, odour, taste, and texture of the extracted gums were evaluated by direct sensory observation. Characteristics such as colour (light brown to off-white), odour (characteristic), taste (tasteless), and texture (smooth) were noted and recorded (Mondal & Tazib Rahaman, 2018).

Solubility Test

Two grams (2 g) each of *C. olitorius* and *S. radiatum* L. gums were placed into 5 mL of different solvents, including cold distilled

water, hot water, ethanol (99.7 %), and chloroform. Each mixture was stirred, and the solubility behaviour whether soluble, insoluble, or sparingly soluble was observed and recorded. This procedure was conducted in accordance with the modified method of (Biswas et al., 2022).

Determination of Ash Value

Two grams (2 g) of each gum sample was placed in a porcelain crucible and heated on a Bunsen flame until it is completely turned to ash. The ash content was expressed as a percentage of the initial sample weight (Biswas et al., 2022).

$$\text{Percentage ash value} = \frac{\text{weight of gum before incineration}}{\text{weight of ash after incineration}}$$

.....Equation 2

Physical Analysis of Mucilage Powder

The dried mucilage of leaves of *Corchorus olitorius* and *Sesamum radiatum L.* was studied for appearance, solubility, Bulk and Tapped Density, compressibility index and Hausner's ratio, Ash Value, Angle of Repose, Moisture Content, Hydration and Swelling Capacity, Flow Rate.

Bulk and Tapped Densities

Ten grams (10 g) of each gum powder was placed into a 50 mL graduated cylinder, and the untapped volume (V_0) was noted. The cylinder was then tapped manually 100 times, and the tapped volume (V_t) was recorded. Bulk and tapped densities were computed using the relationship:

$$\text{Bulk density} = \frac{\text{weight of powder}}{\text{volume occupied by powder}}$$

.....Equation 3

$$\text{Tapped density} = \frac{\text{weight of powder}}{\text{Tapped volume of powdered gum}}$$

.....Equation 4

All determinations were carried out in triplicate, and the mean and standard deviation (SD) were calculated (Akseli et al., 2019).

Angle of Repose

The angle of repose was determined using the fixed funnel method. A glass funnel was clamped on a retort stand at a height of 10 cm above a flat surface. Approximately 50 g of gum powder was allowed to flow freely through the funnel to form a conical heap. The height (h) and radius (r) of the heap were measured, and the angle of repose (θ) was calculated using the equation.

$$\theta = \tan^{-1} \frac{\text{height of the cone } h}{\text{radius of the cone } r}$$

..Equation 5

Each sample was analyzed in triplicate, and the mean \pm SD values were reported as described by (Akseli et al., 2019).

Determination of Hausner's Ratio

Hausner's ratio was determined from the values of tapped and bulk densities according to the equation:

$$\text{Hausner's ratio} = \frac{\text{Tapped density}}{\text{Bulk density}}$$

.....Equation 6

Determination of Carr's Index

Carr's Index (C.I) was computed using the bulk and tapped density values to evaluate the flow property of the powders according to the formula:

$$\text{Compressibility index} = \frac{\text{Tapped density} - \text{Tapped de}}{\text{Tapped de}}$$

..... Equation 7

Determination of Swelling Capacity

The swelling capacity of the gums was determined by placing 1 g of each sample into a 10 mL measuring cylinder. The initial volume (V₀) was recorded, and 10 mL of distilled water was added. After standing for one hour at room temperature, the final volume (V_f) was noted. The swelling capacity was calculated as:

$$\text{swelling capacity} = \frac{\text{swollenvolume}(v_2 - v_1)}{\text{Tapped volume}(v_1)}$$

..... Equation 8

Determination of Moisture Content

Two grams (2 g) of each gum powder was weighed into a clean, pre-weighed crucible and placed in an oven at 60 °C. The samples were heated for five minutes, cooled in a desiccator for three minutes, and reweighed. The process was repeated until constant weight was obtained. The percentage moisture content was calculated as:

$$\% \text{ moisture content} = \frac{\text{weight loss}(w_1 - w_2)}{\text{intial weight}} \times 100$$

..... Equation 9

Determination of Hydration Capacity

One gram (1 g) of gum was placed in a centrifuge tube and mixed with 10 mL of distilled water for two minutes. The mixture was centrifuged at 3000 rpm for ten minutes. The supernatant was decanted, and the sediment was weighed. Hydration capacity was then calculated using the formula:

$$\text{Hydration capacity} = \frac{\text{weight of thesediments}}{\text{weight of dry sample}}$$

..... Equation 10

Phytochemical Screening

Various tests were carried out to determine the phytochemicals present in the extracted gums. These includes; Dragendorff's / Mayer's Test to determine the presence of alkaloids, Keller–Kiliani Test to determine the presence of cardiac glycosides, Borntrager's Test to determine the presence of anthraquinones, as test for carbohydrates, Salkowski / Liebermann–Burchard Test to determine the presence of terpenoids and steroids, Ferric Chloride Test to determine the presence of Flavonoids and Tannins, and Froth (Foam) Test to determine the presence of saponins.

Preparation of the Emulsion

An oil-in-water emulsion was prepared using castor oil as the oil phase and deionized water as the aqueous phase at a ratio of 2:8 v/v (20 mL oil + 80 mL water = 100 mL emulsion). The gums from *C. olitorius* and *S. radiatum* were used as natural emulsifying agents and acacia as the standard gum. Each gum sample was mixed with the oil in a mortar, and 10 mL of water was added and triturated until a cracking sound was heard, indicating primary emulsification. The resulting mixture was transferred into a 100 mL volumetric flask and made up to volume with water. Emulsions were prepared at varying gum concentrations of 0.4 %, 0.6 %, 0.8 %, 1.0 %, and 1.2 % w/v. Acacia gum served as the standard reference emulsifier (F. Ma et al., 2017).

Determination of Emulsion Type

Three drops of Amaranth dye were added to 10 mL of each emulsion. The type of emulsion was determined based on colour distribution, a red colouration of the continuous phase indicated an oil-in-water (O/W) emulsion, whereas colouration of dispersed globules indicated a water-in-oil (W/O) type (F. Ma et al., 2017).

Creaming Index of the Emulsion

Each emulsion formulation was centrifuged at 3000 rpm for 10 minutes. The height of the cream layer (H_c) and the total height of the emulsion (H_e) were measured, and the creaming index (C.I) was calculated using the formula:

$$\text{C.I. (\%)} = \frac{H_c}{H_e} \times 100$$

This was conducted according to the method of Junqueira (F. Ma et al., 2017)

Determination of Viscosity

Viscosity measurements were carried out using a viscometer (NDJ-8S, PEC Medical,

USA) at 25 °C. Shear rates corresponding to 6, 12, 30, and 60 rpm were applied using spindle size 3. The readings were recorded, and the mean viscosity values were determined for each gum concentration.

Determination of Density

Densities of 20 mL of emulsions containing varying gum concentrations were determined by measuring the ratio of the mass of the emulsion to its corresponding volume. The measurements were carried out in triplicates, and the mean \pm standard error of mean (SEM) was calculated for each formulation.

Stability Tests

Long-term stability tests were conducted for three weeks. The emulsions were stored undisturbed at room temperature (25 °C) and observed weekly for physical changes such as creaming, cracking, or phase separation. The degree of stability was noted for each gum concentration.

Table 1: Formula for the Various Emulsion Formulations *Corchorus olitorius* mucilage and *Sesamum radiatum L.* mucilage with Standard Acacia Gum

Batch	Gum (g)	Oil (mL)	Water to (mL)
COM1 (0.4 %w/v)	0.4	20	100
COM2 (0.6 %w/v)	0.6	20	100
COM3 (0.8 %w/v)	0.8	20	100
COM4 (1 %w/v)	1	20	100
COM5 (1.2%w/v)	1.2	20	100
SRM1 (0.4 %w/v)	0.4	20	100
SRM2 (0.6 %w/v)	0.6	20	100
SRM3 (0.8 %w/v)	0.8	20	100
SRM4 (1 %w/v)	1	20	100
SRM5 (1.2 %w/v)	1.2	20	100
SAG1 (1 %w/v)	1	20	100

Key: COM: *Corchorus olitorius* mucilage and SRM: *Sesamum radiatum L.* mucilage with varying concentrations ranging from 0.4% to 1.2% w/v. SAG: Standard Acacia gum

Data Analysis

Data collated was analyzed on Microsoft Excel 2016 and the means and standard deviations for replicate measurements were determined. All the values are expressed as mean \pm standard deviation.

Results

The percentage yield for *Corchorus olitorius* and *Sesamum radiatum L.* after extraction is 10% and 9.5% respectively.

Table 2: Organoleptic Properties of *Corchorus olitorius* mucilage and *Sesamum radiatum L.* mucilage with Standard Acacia Gum

Parameter	COM	SRM	SAG
Colour	Light brown	Brown	Off white
Odour	Characteristic odour	Characteristic odour	Characteristic odour
Texture	Smooth	Smooth	Smooth
Taste	Tasteless	Tasteless	Tasteless

KEY: COM= *Corchorus olitorius* mucilage, SRM= *Sesamum radiatum L.* mucilage, SAG= Standard acacia gum powder

Table 3: Solubility profile of *Corchorus olitorius* mucilage and *Sesamum radiatum L.* mucilage with Standard Acacia Gum in different solvents.

Solvent	COM	SRM	SAG
Ethanol	Insoluble	Insoluble	Insoluble
Acetone	Insoluble	Insoluble	Insoluble
Chloroform	Insoluble	Insoluble	Insoluble
Hot water	Soluble	Soluble	Soluble
Cold water	Sparingly soluble	Sparingly soluble	Soluble

KEYS:

**COM= *Corchorus olitorius* mucilage, SRM= *Sesamum radiatum L.* mucilage
SAG= Standard acacia Gum powder**

Table 4: Physicochemical properties of *Corchorus olitorius*, *Sesamum radiatum L.* gum and acacia gum.

Parameters	COM \pm SEM	SRM \pm SEM	SAG \pm SEM
Bulk density (g/mL)	0.925 \pm 0.006	0.918 \pm 0.005	1.170 \pm 0.013
Tapped density (g/mL)	1.065 \pm 0.004	1.058 \pm 0.006	1.601 \pm 0.009

Carr's index (%)	12.980 ± 0.070	13.220 ± 0.068	26.740 ± 0.490
Hausner's ratio	1.140 ± 0.003	1.152 ± 0.002	1.361 ± 0.007
Hydration capacity	7.610 ± 0.052	7.530 ± 0.048	9.540 ± 0.095
Angle of repose (°)	26.985 ± 0.061*	27.130 ± 0.064*	39.100 ± 0.057
Moisture content (%)	0.428 ± 0.002	0.431 ± 0.003	4.760 ± 0.059
Swelling capacity (%)	78.340 ± 0.075*	78.110 ± 0.079*	15.760 ± 0.068
Ash value (%)	7.610 ± 0.050	7.540 ± 0.054	9.590 ± 0.045

KEYS:

COM= *Corchorus olitorius* mucilage, SRM = *Sesamum radiatum L.* mucilage

SAG= Standard acacia Gum, SEM = *Standard Error of the mean* Values are expressed as Mean ± SEM (n=3). (*) indicate statistically significant differences (p < 0.05) when compared with the standard

Table 5: Comparative Phytochemical Screening Results

Phytochemical	Specific Test	COM	SRM	SAG
Carbohydrates	Molisch's Test	+	+	+
Alkaloids	Dragendorff's	+	+	+
	Mayer's Test			
Flavonoids	Ferric Chloride Test	+	+	+
Saponins	Froth Test	+	+	+
Tannins	Ferric Chloride Test	+	+	+
Anthraquinones	Borntrager's Test	-	-	-
Cardiac Glycosides	Keller-Kiliani Test	+	+	-
Terpenoids & Steroids	Salkowski Test	-	-	+

Key: + = Detected, - = Not Detected, COM= *Corchorus olitorius* mucilage, SRM = *Sesamum radiatum L.* mucilage SAG= Standard acacia Gum

Table 6: Results of Dye Solubility Test of *Corchorus olitorius* mucilage and *Sesamum radiatum L.* mucilage with Standard Acacia Gum

Emulsion Sample	Type of Dye	Observation	Interpretation
COM	Amaranth	No coloured globules; red colour in external phase	O/W type
SRM	Amaranth	No coloured globules; red colour in external phase	O/W type
SAG	Amaranth	No coloured globules; red colour in external phase	O/W type

Key: COM= *Corchorus olitorius* mucilage, SRM= *Sesamum radiatum L.* mucilage, SAG= Standard acacia gum, O/W= oil-in-water

Table 7: Viscosity of the Emulsion of *Corchorus olitorius* mucilage and *Sesamum radiatum L.* mucilage with Standard Acacia Gum at Various Shear Strengths

Sample (%w/v)	Viscosity of emulsion (mPa.s)			
	6 rpm	12 rpm	30 rpm	60 rpm
DW (0)	0.00	0.00	0.00	0.00
COM (0.4)	300.66 ± 0.37	170.86 ± 0.46	60.93 ± 0.47	34.49 ± 0.27
COM (0.6)	560.93 ± 0.54	360.49 ± 0.25	120.37 ± 0.19	34.93 ± 0.49
COM (0.8)	540.69 ± 0.35	340.75 ± 0.41	136.89 ± 0.49	43.09 ± 0.56
COM (1.0)	441.00 ± 0.51*	270.70 ± 0.45*	84.98 ± 0.56*	42.76 ± 0.45
COM (1.2)	620.78 ± 0.39	440.67 ± 0.44	180.97 ± 0.55	60.50 ± 0.28
SRM (0.4)	159.96 ± 0.50	169.88 ± 0.13	122.29 ± 0.38	23.21 ± 0.61
SRM (0.6)	559.66 ± 0.57	360.35 ± 0.32	120.14 ± 0.65	33.01 ± 0.54
SRM (0.8)	530.18 ± 0.09	339.47 ± 0.73	136.09 ± 0.51	41.93 ± 0.53
SRM (1.0)	440.33 ± 0.32*	270.16 ± 0.99*	99.41 ± 0.35*	41.49 ± 0.67
SRM (1.2)	619.31 ± 0.36	380.36 ± 0.76	116.27 ± 0.85	38.16 ± 0.70
SAG (1.0)	580.40 ± 0.46	410.20 ± 0.43	165.55 ± 0.49	47.80 ± 0.30

DW = Distilled water at zero concentration COM = *Corchorus olitorius* gum SRM = *Sesamum radiatum L.* gum rpm = Revolutions per minute Values are expressed as Mean ± SEM (n=3). (*) indicate statistically significant differences (p < 0.05) when compared with the standard

Table 8: Densities of 20 mL Emulsions containing different *Corchorus olitorius* mucilage and *Sesamum radiatum L.* mucilage with Standard Acacia Gum concentrations (mean \pm SEM, n = 3)

Density of emulsion (g/cm ³)			
Concentration (% w/v)	SAG	COM	SRM
0.4	-	1.003 \pm 0.01	1.006 \pm 0.01
0.6	-	1.018 \pm 0.02	1.019 \pm 0.02
0.8	-	1.034 \pm 0.01	1.036 \pm 0.01
1.0	1.045 \pm 0.02	1.046 \pm 0.02	1.044 \pm 0.02
1.2	-	1.060 \pm 0.02*	1.057 \pm 0.02*

Key: COM= *Corchorus olitorius* mucilage, SRM= *Sesamum radiatum L.* mucilage, SAG= Standard acacia gum Values are expressed as Mean \pm SEM (n=3). (*) indicate statistically significant differences (p < 0.05) when compared with the standard

Table 9: Creaming index of emulsions containing *Corchorus olitorius* mucilage and *Sesamum radiatum L.* mucilage with Standard Acacia Gum at different gum concentrations

Concentration (% w/v)	COM (%)	SRM (%)	SAG (%)
0.4	5	8	-
0.6	7	12	-
0.8	9	16	-
1.0	10	19	20
1.2	11	22	-

Key: COM= *Corchorus olitorius* mucilage, SRM= *Sesamum radiatum L.* mucilage, SAG= Standard acacia gum,

Table 10: Creaming index of Formulated Emulsions stored at ambient conditions over three weeks

Emulsion Type	Concentration (% w/v)	24 h	72 h	168 h	336 h	504 h
COM	0.4	15	32	55	60	78
	0.6	10	22	40	58	75
	0.8	6	14	28	52	60
	1.0	3	7	15	30	45
	1.2	11	13	15	34	40
SRM	0.4	40	75	89	70	75
	0.6	32	65	66	72	75
	0.8	25	55	57	70	73
	1.0	18	45	58	68	72
	1.2	12	35	65	68	70
SAG	1.0	28	55	60	69	75

Key: COM= *Corchorus olitorius* mucilage, SRM= *Sesamum radiatum L.* mucilage, SAG= Standard acacia gum, O/W= oil-in-water

Discussion and Conclusion

Discussion

The extraction yields *Corchorus olitorius* mucilage and *Sesamum radiatum L.* mucilage recorded which are 10 % for COM and 9.5 % for SRM align closely with the 10.52 % yield reported for *Corchorus olitorius* mucilage by (Oh & Kim, 2022), who used hot-water extraction in their study of functional properties. This suggests that the extraction protocol applied in the present work achieves a comparable recovery rate to that in the literature. (Assi et al., 2017) reported a much higher mucilage content (~25.81 %) in *C. olitorius* leaves from Côte d'Ivoire; however, their methodology (including plant part, extraction method, drying and measurement basis) differed significantly, which may account for the disparity. The relatively strong yield of COM in the current study therefore places it favourably among natural mucilages, and the slightly lower yield of SRM is consistent with

the more limited prior data on *Sesamum radiatum L.* mucilage.

In the organoleptic assessments (Table 2), COM and SRM exhibited smooth texture, characteristic odour and tasteless taste qualities favourable for excipient use. The colour differences (light brown for COM, brown for SRM, off-white for standard acacia gum) reflect the typical consequence of plant-derived polymers having minor residual pigments or non-polysaccharide constituents, as seen in other plant excipient studies (Yandrapalli, 2024). These observations mean that, while organoleptic attributes are acceptable, formulation designers should anticipate potential colour correction or masking if visual appearance is critical.

The solubility profiles of both COM and SRM as indicated in table 3 were insoluble in ethanol, acetone and chloroform, soluble in hot water, and only sparingly soluble in cold water (unlike the standard gum which was

fully soluble). The results mirror those of (Oh & Kim, 2022)

who found that *C. olitorius* mucilage achieved ~79.5 % solubility at 65 °C but did not emphasize cold-water solubility. The limited cold-water solubility of COM and SRM suggests polymer architecture (such as high molecular weight, branching or strong hydrogen bonding) may slow dispersion at lower temperatures. In contrast, more soluble gums (e.g., tamarind seed mucilage) have been reported to dissolve more readily in cold water (Shady et al., 2022). Thus, these solubility results indicate a formulation constraint: dissolution conditions (e.g., heating or longer stirring) may be required when using COM or SRM.

The detailed physicochemical properties (Table 4) revealed several comparative strengths of COM/SRM over the standard gum. Bulk and tapped densities of COM/SRM were lower, and the Carr's index (~13 %) and Hausner's ratio (~1.14–1.15) indicate superior flowability compared to the standard acacia gum (~26.7 %, ~1.36). The swelling capacities are markedly high (~78 % for COM/SRM vs ~15.8 % for standard), which suggests strong water uptake and network-forming ability. Previous research by (Oh & Kim, 2022) found that *C. olitorius* mucilage, when used as a suspending agent, exhibited flow and density values comparable to standard excipients at lower concentrations. The high swelling capacity in the present work suggests enhanced thickening/emulsifying potential. Conversely, hydration capacity was slightly lower for COM/SRM compared to the standard, indicating slower initial water

uptake consistent with other natural mucilages (Akseli et al., 2019). Practically, these data mean that COM and SRM could offer processing advantages (better flow, high swelling) but may require longer time or energy input to hydrate fully.

Phytochemical screening (Table 5) demonstrated that COM and SRM both contain secondary metabolites such as flavonoids, tannins and alkaloids, whereas terpenoids/steroids were detected only in the standard gum. This aligns with the notion that plant-derived mucilages frequently contain non-polysaccharide constituents that may affect excipient behaviour (Oh & Kim, 2022). For example, such components could influence drug-excipient interactions, hydrolytic stability or even impart slight bioactivity. Therefore, while COM and SRM appear physically and functionally acceptable as excipients, their phytochemical complexity suggests that compatibility testing (with active pharmaceutical ingredients) is prudent.

The dye solubility test (Table 6) indicated that emulsions prepared with COM, SRM and the standard gum were all oil-in-water (O/W) types. This confirms that the experimental gums perform the primary functional role of forming O/W emulsions. A prior study of *S. radiatum* gum as emulsifier/stabilizer found that the gum, when used as a stabilizer in combination with acacia, produced smaller globule sizes (1.68–1.95 µm) compared to acacia alone (3.95 µm) in four-week emulsions (Abdel-Razek et al., 2022). The present finding supports that *S. radiatum* mucilage can contribute to O/W systems, though in the prior work the gum did not form

emulsions alone under 4:2:1 ratio. The implication is that, in the current study, COM and SRM are viable in O/W systems without necessarily requiring auxiliary emulsifiers, which is a notable advantage.

The rheological data in Table 7 show that viscosity increases with gum concentration and decreases with shear rate indicative of shear-thinning behaviour common to polymer-stabilized emulsions (Froelich et al., 2023). In the case of COM, 1.2 % w/v achieved ~ 620.8 mPa·s at 6 rpm and ~ 60.5 mPa·s at 60 rpm. The high viscosity at low shear suggests a strong network in the continuous phase, which contributes to emulsion stability. Previous work on *C. olitorius* mucilage (Oh & Kim, 2022) highlighted that increased mucilage concentration enhanced both viscosity and emulsifying stability, providing qualitative alignment with the present data. In contrast, other plant mucilages (e.g., fenugreek seed mucilage) have shown lower viscosity build-up at comparable concentrations (Biswas et al., 2022). Therefore, these findings bolster the suitability of COM (and to a somewhat lesser extent SRM) as stabilizers in emulsions.

Density measurements (Table 8) revealed that emulsions with COM and SRM showed increasing density with increasing gum concentration (e.g., COM from 1.003 g/cm³ at 0.4% to 1.046 g/cm³ at 1.0%), which is favourable for reducing creaming due to reduced density difference between phases. Literature on natural gum-stabilized emulsions supports that higher aqueous phase density contributes to creaming resistance (Lakshmi Rajyam et al., 2021). The

similarity of densities between COM/SRM and the standard gum indicates that substitution is feasible without major density-driven destabilization risk.

The creaming index (CI) results (Tables 9 & 10) provide compelling comparative insight. In short-term (Table 9), at 1.0% w/v, COM achieved 10 % CI compared to 19 % (SRM) and 20 % (standard). In long-term storage to 504 h (Table 3.11), COM's CI increased from 3 % at 24 h to 45 % at 504 h, while SRM increased to 72 % and the standard to 75 %. These findings show that COM offers markedly superior long-term kinetic stability in O/W emulsions. The observed trend mirrors that reported for *C. olitorius* mucilage used as a sustained-release matrix former in ibuprofen tablet studies (Prajapati et al., 2024) where higher polymer concentration produced slower release and greater structural integrity over time. The data reinforce that COM is particularly important as an emulsion stabilizer. On the other hand, SRM's higher CI suggests that while functional, it may require higher concentration, co-emulsifier addition or other stabilization strategies to match COM.

When compared with multiple published works across different plant mucilages and gums, the present results position COM mucilage as an excipient with favourable extraction yield, powder and functional properties, rheology, emulsion stability and applicability in O/W systems comparable or superior to both the standard acacia gum and other reported natural gums. SRM appears promising but lags in some functional parameters and therefore may warrant further optimization.

Conclusion

The comparative evaluation of *Corchorus olitorius* (COM) and *Sesamum radiatum* L. (SRM) mucilages as natural emulsifying agents demonstrated that both possess promising physicochemical and functional characteristics, with *C. olitorius* exhibiting distinctly superior performance across several parameters. Functionally, COM and SRM demonstrated effective emulsifying capability, producing stable oil-in-water emulsions like those stabilized by acacia gum. Overall, the findings position *C. olitorius* mucilage as a viable, cost-effective, and environmentally sustainable alternative to standard acacia gum in oil-in-water emulsions, particularly suitable for use in resource-limited pharmaceutical laboratories.

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Its excellent swelling, viscosity, and stability properties make it a strong candidate for formulation as a natural emulsifier or suspending agent. In contrast, while *S. radiatum* mucilage exhibited satisfactory emulsifying properties, its higher creaming index and lower cold-water solubility indicate the need for further optimization or potential use as a co-stabilizer rather than a primary emulsifier.

Declaration of Interest

The authors declared no conflict of interest.

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