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Screening of *Acacia* Gum as a potential excipient for Pharmaceutical Dosage forms

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Abstract

The physicochemical characterization of Acacia gum demonstrates its potential for pharmaceutical applications. The gum lacks tannin and dextrin, has moisture content and ash values within pharmacopeial limits, and is soluble in water but insoluble in organic solvents. It exhibits excellent flowability and compressibility, making it suitable for formulation purposes. Acute oral toxicity studies in mice indicate safety up to 5 g/kg body weight. In pharmaceutical formulations, Acacia functions as an emulsifying agent, thickener, viscosity-increasing agent, and binder, particularly in buccal and lozenge-type dosage forms. Its rapid hydration in water enables handling of concentrations up to 40-50%, though it exhibits relatively low viscosity compared to other gums. For instance, while a 1% Xanthan gum dispersion yields a viscosity of 3000-5000 mPa·s, Acacia requires a 40% dispersion to achieve similar viscosity. Thus, Acacia is often combined with other gums or thickeners for enhanced efficacy in suspensions and emulsions.Acacia is utilized in the preparation of buccal tablets (pastilles and lozenges) and occasionally as a tablet binder when prolonged disintegration times are desired. It stabilizes oil emulsions, serves as a component in tablet coatings, and acts as a base for chew formulations at concentrations of 1%. Additionally, Acacia gum finds use in topical and cosmetic formulations as a natural alternative to synthetic emulsifiers, stabilizers, and thickeners.These versatile properties underscore Acacia gum's value in both pharmaceutical and cosmetic industries, promoting its use as a functional and safe excipient.

Key words : Gum Acacia, Natural polymers, Gum, Pharmaceutical application.

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Excipients are primarily employed as diluents, binders, disintegrants, adhesives, glidants and sweeteners as in ancient indefinite quantity forms like tablets, capsules *etc*., because the institution of toxicity and approval from restrictive authorities advises a giant downside with artificial Excipients, additional interest is being shown by researchers within the field of flavouring Excipients. Additionally, to traditional pharmaceutical Excipients as bulking agents, a substance used for masking taste/texture or as a substance used to help throughout the production method, novel Excipients supply a broad variety of properties appropriate to preserve the integrity of active constituents of the formulation and improve their shelf life. Excipients are the substances or compounds,apart from the active pharmaceutical ingredients and packaging materials, that have an effect on finished product quality, in some cases creating up nearly the entire formulation. They are essential within the good planning of the pharmaceutical merchandise. Pharmaceutical Excipients are crucial to drug delivery inside the body. Generally, an excipient has no medicinal properties.

A. Gum *Acacia :*

Gum arabic (gumacacia, gumsudani, Senegal gum and by other names) is a natural gum originally consisting of the hardened sap of two species of the *Acacia* tree, *Senegalia senegal*[2] and *Vachellia seyal*. However, the term"gumarabic" does not actually indicate a particular botanical source. The gum is harvested commercially from wild trees, mostly in Sudan (80%) and throughout the Sahel, from Senegal to Somalia. The name "gum Arabic" (*al-samgh al-'arabi*) was used in the Middle East at least as early as the 9th century. Gum Arabic first found its way to Europe via Arabic ports, so retained its name [Wade A. *et. al*. 1994].

B. *Neem Gum :*

Neem consists of almost all the part of the plant which are used as drug of Azadirachta indica. It is belonging to family ***Meliaceae.*** It is also known as margosa, indian Lilac and Azadirachta indica. India is native of *Azadirachta*. It is also cultivated in Nepal Pakistan Bangladesh and Sri- Lanka. Neem is a fast growing tree that can reach a height of 15-20 m, rarely to 35-40m. It is evergreen [19,20].

A. Chemical Tests of *Acacia :*

Lead acetate test: An aqueous solution of acaciagum when treated with lead acetate solution yields a heavy white precipitate. Reducing sugars test: Hydrolysis of an aqueous solution of Acacia with dilute HC1 yields reducing sugars whose presence are ascertained by boiling with Fehling's solution to give a brick-red precipitate of cuprous oxide. Blue colouration due to enzyme: When the aqueous solution of Acacia is treated with benzidine in alcohol together with a few drops of hydrogen peroxide (H_2O_2), it gives rise to a distinct blue colour due to the presence of oxidases enzyme. Borax test: An aqueous solution of acacia affords a stiff translucent mass on treatment with borax. Specific test: A 10% aqueous solution of acacia fails to produce any precipitate with dilute solution of lead acetate (a clear distinction from Agar and Tragacanth); it does not give any colour change with Iodine solution (a marked distinction from starch and dextrin); and it

Morphology of *Acacia :*

Colour	Tears are usually white, pale-yellow and sometimes creamish-brown to red in colour. The powder has offwhite, pale-yellow or light-brown in appearance.
Odour	Odourless
Taste	Bland and mucilaginous
Shape and Size	Tears are mostly spheroidal or ovoid in shape and having a diameter of about 2.5-3.0 cm
Appearance	Tears are invariably opaque either due to the presence of cracks or fissures produced on the outer surface during the process or ripening. The fracture is usually very brittle in nature and the exposed surface appears to be glossy.

never produces a bluish-black colour with $FeCl_3$ solution (an apparent distinction from tannins).

➢ Sample preparation

The dried exudate gum arabic and commercial gum was purchased from Yucca Interprises, Wadala Mumbai. The gum arabic was washed under running tap water to remove the surface dirt. Then, it was dried in an oven (Memmert Oven, Germany) at 60±2°C for 24 hrs. Mortar and pestle were used to grind the dried material, which was followed by a sieving process for 20 mins using a vertical vibratory sieve shaker (Labortechnik GmbH, Ilmenau). Five different sieves with an aperture size of 63, 125, 250, 500 and 1000 μm were used to collect the varying particle sizes required for this study. Finally, the powder was packed in polyethylene zipped bags (12 cm x 12 cm) and stored at 4±2°C prior to analysis.

➢ Particle size analyzing

The particle size distribution of gum arabic powder was determined using a dry dispersion unit of Malvern Mastersizer 2000 particle size analyzer (Malvern Instrument Ltd, Worcester-shire, UK). About 1 g of powder was placed in a stirring cell (volume 10 mL) with an obscurity value of 0.12 to 0.18 with the air pressure set to 2.0 bars. The classification of particle sizes is shown in Table-1.

➢ Proximate analysis

The proximate analyses of moisture, ash, crude protein, crude lipid, and dietary fiber of the gum arabic powder were analysed according to the AOAC methods (AOAC, 2002). The moisture content of the sample was measured using the oven drying method at 105°C for 24 hrs. In order to determine the ash content, the samples were incinerated at 550°C for 6 hrs. Whereas,

Kjeldahl method (N x 6.25), Soxtech (Model-2050 Foss, Denmark) and Fibertech (Model-2010 Foss, Denmark) were used to measure the total protein, fat and fiber contents, respectively. Total carbohydrate content was determined by the difference [100 - (moisture + ash + protein + lipid)].

- Density analysis

- True density

A gas pycnometer (Accu Pyc II 1340, Micromeritics, Norcross, USA) was used to measure the true density. This device used the gas displacement method for an accurate volume measurement. Once the sample was placed in a chamber with a known volume, the helium gas was released and allowed to expand into the other precision internal volume. The sealed chamber with the sample in it was then pressurised to achieve the desired pressure with gas displacement. The pressure was recorded upon stabilisation. Once stabilised, the gas was allowed to expand into a reference chamber with a known volume when the valve is opened. Once the pressure in the reference chamber stabilised, the second pressure was recorded.

- Bulk density

Approximately 2 g of gum arabic powder, *m*, was transferred to a 10 mL graduated cylinder and the volume of the sample powder occupied (*Vb*) was recorded. The bulk density (ρb) was determined using the following equation:

$Pb = M / Vb$

- Tapped density

Approximately 2 g of gum arabic powder, *m*, was transferred to a 10 mL graduated cylinder and the cylinder was mechanically tapped up and down 100 times. Then, the volume that the sample powder occupied (*Vt*) was recorded. The tapped density (ρt) was calculated using the following equation:

$Pt = m / v\ t$

- Hausner ratio

Hausner ratio (*HR*) is an index that corresponds to the flow ability of a powder or granular material (Hausner, 1967). It was determined using the following equation:

$HR = pt / pb$

Where, *ρt is tapped density, ρb is bulk density.*

- Carr index

Carr index (*CI*) or Carr's compressibility index is an indication of the compressibility of a powder (Carr, 1965). It was determined using the following equation:

$CI = (pt - pb) / pt \times 100$

Where, *ρt is tapped density, ρb is bulk density.*

- Angle of repose

The angle of repose was determined manually by calculating the dimensions of the powder pile. The powder was passed through a lifted funnel to form a powder heap. Then, the angle of repose (θ) was calculated by measuring the radius (*r*) of the base and height (*h*) of the conical powder heap formed using the formula below:

$\tan \theta = h / r$

- Water activity

Water activity of gum arabic was measured using a water activity meter (Model 3TE, Aqualab, WA). Approximately 2 g of the powdered sample was filled into a sample cup and the water activity was determined at room temperature (25±1°C).

➢ Hygroscopicity

Approximately 1 g of gum arabic powder was placed in a sealed humidity desiccator containing a saturated sodium chloride solution (76±2% relative humidity) and was incubated at 25±1°C for one week. The hygroscopicity (*HG*) value was determined using the following equation:

HG = (W1-W2) / W1 x 100

Where, *W2* is the weight of powder after equilibrium and *W1* is the initial mass of powder.

➢ Swelling index

Approximately 5 g of gum arabic powder was transferred gently into a 200 mL measuring cylinder where the bulk volume, V1 was measured. Then, distilled water was added to disperse the gum until the volume reaches the 100 mL mark. The dispersion was allowed to stand for 24 hrs and the volume of the swollen gum, V2 was recorded. All measurements were performed in duplicates. The swelling index (*SI*) was determined using the following equation:

SI= V2 / V1

➢ Emulsion capacity

The emulsification capacity (*EC*) yielded from the gum arabic used in this study was compared with the commercial gum. Gum arabic aqueous solutions were prepared with water to produce 5 dispersions. Commercial corn oil (1% v/v) was added to these dispersions. The amount of gum arabic in each dispersion was adjusted to yield 0.1, 0.25, 0.50, 0.75, 1.0% w/v concentration in the final mixture. A vortex was used to homogenize each mixture for 1 min. Finally, all 5 dispersions were centrifuged at 800 x *g* for 10 mins. The *EC* was calculated using the following equation (Sciarini *et al.,* 2009):

EC= (ev / tv) x 100

where, *ev* is the emulsion volume and *tv* is total volume.

➢ Emulsion stability

The emulsion stability (*ES*) against high temperature was estimated by incubating the solution at 80°C for 30 mins in a water bath. The solution was centrifuged at 800 x *g* for 10 mins following incubation. The calculation involved to determine *ES* is shown below (Sciarini *et al.,* 2009).

ES= (f ev /ie v) x 100

Where, fev is final emulsion volume, and *iev* is initial emulsion volume.

Collection of materials:

Acaia Gum Highly analytical Grade is purchase from Yucca Enterprises Mumbai

Neem Gum

A. Purification of Neem Gum

The neem gum was purified before use. Reported literature indicated typical and complex process of neem gum (Ramakrishna, 1981). Hence, the present work we followed simple purification method based on swelling parameters of gum. The visible debris and non-gum parts were removed, and the exudates were soaked in purified water overnight. The impurities were removed, and soft swollen mass was collected in stainless steel trays and dried at 40-50°C for 10-12 hours. The dried gum was collected, powdered and passed through sieve no #80. Then, powdered gum was kept in airtight container until further use.

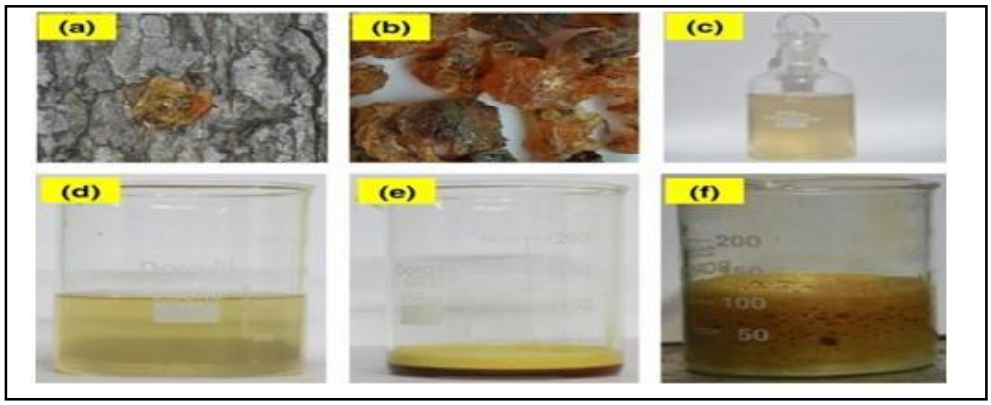

Figure 1. Removal of Impurities from Neem Gum

B. Characterization of Neem Gum

Preliminary screening of gum.

The preliminary pharmacognostic screening studies was done for presence of carbohydrates, mucilage, polysaccharides, enzyme, alkaloids, flavanoids, terpenoids, tannins, steroids, proteins and amino acids, glycosides and phenolic compounds was performed.

C. Phytochemical and Physicochemical Evaluation of Neem Gum

Qualitative analysis of neem gum was performed as per the standard procedure to confirm the phytochemical nature of the mucilage. Physicochemical parameters such as appearance, color, odor, solubility, pH, loss on drying, swelling index , total ash, water soluble ash, water insoluble ash, acid insoluble ash, moisture uptake, specific gravity was studiedfor neem gum.

- Appearance :

About 2.0 grams of gum sample was taken on a clean dried watch glass and observed visually for the physical form and appearance.

- Color:

About 2.0 grams of gum sample was taken on a clean dried watch glass and observed visually for the colour.

- Odour:

About 2.0 grams of gum sample was taken on a clean dried watch glass and observed for odour.

- Solubility:

Aqueous Solubility of gum was studied using purified water. Weighed quantity (100 mg) of gum was added to 10 ml of purified water and mixed thoroughly for 15 to 30 minutes with intermittent shaking and observed physically. The sample is subjected to gentle heating and observed for solubility.

- pH :

The gum sample was taken in powdered form and was dissolved in distilled water to obtain 10 % w/v mixture. The mixture was then heated gently on a water bath for 20 mins and then filtered. Then using a pH meter, the pH of the filtrate was measured at 25°C.

- Loss on drying (LOD):

For estimating the loss on drying, 10 g of the drug sample was accurately weighed and taken in an evaporating dish and dried for 5 hrs at 105°C. The drying process was continued at

1 hr interval till the successive weight difference does not correspond to more than 0.25 percent.

D. Collection and purification of Neem gum
The Neem gum were collected / Purchased from Yucca Enterprises from Mumbai.

E. Processing of Neem gum Slurry
The Neem Gum was collected from the Neem trees by making incisions and left over for few days to produce the gum. The gum was collected and allowed to dry at room temperature before being used. The dried gum was ground in a mortar and passed through sieve No.60. In distilled water, neem gum (25 g) was solubilized (250 ml) and to this solution 20 ml of acetone was added to precipitate gum. The precipitate of gum was dissolved in 50 ml of water and 20 ml of ethanol was added to precipitate the gum again. It was separated by using muslin cloth; air dried, pulverised and kept in an airtight container. Purified neem gum 18 g was obtained out of 25 g of original gum.[4]

F. Phytochemical screening of Neem gum
The presence of alkaloids, glycosides, carbohydrate, proteins, amino acids, mucilage and tannins, was determined.[5] (Table-1)
Determination of pH
Neem gum (2 g) was dissolved in distilled water (100 ml), whose pH was measured using a pH meter. Measurement of viscosity
A digital Brookfield viscometer was used for the measurement of viscosity of gum solution (5 & 7.5 %w/v). The spindle speed rotation was kept at 20 rpm.

Loss on drying

Accurately 5 g of neem gum was weighed and dried at 100 ± 2°C using hot air oven to get constant weight of the gum (Table-2).

Fourier-transform infrared (FT-IR) studies
These investigations were carried out to see whether there was any interaction between the Drug and the neem gum in addition to the excipients used in the formulation. Physical mixture of drug, excipients and tablet formulations were studied for FT-IR spectra. Whatman filter paper was used to filter the suspension formulation, and the residue was employed for the FT-IR investigation.[6]
Scanning electron microscopy
To further understand the surface morphological characteristics of purified neem gum powder, SEM experiments were performed.

Differential scanning calorimetry (DSC):

G. Evaluation of Neem Gum suspension
The Neem Gum suspensions were evaluated for physical stability, redispersibility, sedimentation volume and viscosity.
Physical test
The prepared suspensions were observed every day for any physical changes such as aggregation, caking and crystal growth formation, for 4 weeks[7].
Re-dispersibility
The redispersibility of test suspensions was carried out as per Saeidi *et al*. with slight modifications[8]. Fifty millilitres of test suspensions was kept in a measuring cylinder (50 mL) at room temperature. The measuring cylinder was gently rotated at 180° at regular 24-h intervals. The number of turns required for uniform redispersion of sediment of suspension was noted. The results recorded are the mean of three determinations.
Determination of sedimentation volume
The sedimentation volume of the suspensions was determined by keeping 50 mL of each

suspension in a stoppered measuring cylinder and stored in undisturbed condition at room temperature. The sedimentation volume was noted when suspending particles settled down and the cloudy supernatant started to clear up. The sedimentation volume of each formulation was noted every 24 h for 4 days. The % sedimentation volume was calculated using the following equation[9].

Determination of viscosity of suspension

The effect of concentration of NG on the viscosity of suspension was determined using the Brookfield synchroelectric viscometer at 25 °C (RVDVPRO II; Brookfield, USA) at 100 rpm (spindle number 4). The viscosity of suspensions was determined within 24 h of its preparation. The results were compared with CMC added suspension formulations. The results are expressed as the mean of three determinations[9].

Determination of flow rate

The flow rates were determined as the time required to pass the 10 mL of suspension using 10 mL standard pipette[1]. The results are expressed as the mean of three determinations.

Stability study

The stability of NG suspensions was determined using the stability chamber. The conditions maintained were the real-time condition of 30 °C/65% relative humidity (RH), accelerated condition of 40 °C/75% RH and in a refrigerator at 4°C for 3 months. Samples were collected at 0, 30, 60 and 90 days. The stability of the suspensions was analysed by visual inspection such as physical appearance; the pH was also noted[10]. The results recorded are averages of triplicate determi-nations.

Gum Acacia

Table-1. Physical observation of Acacia Gum

Test	Observation
Odour	Odourless
pH	4.5
Appearance	Glassy appearance
Solubility	The solubility in water is 43-48%
Emulsifying	30%
Solubility	Soluble in any proportion in water. Soluble in Glycerol, Propylene glycol but insoluble in Ethanol. Hydrates slowly to produce a colourless or yellowish, viscous, gummy solution. Spray-dried grades hydrate much more rapidly (generally <30 minutes)
Moisture uptake	8 – 13% equilibrium moisture uptake at relative humidities of 25-65% / 25 °C. Acacia is hygroscopic
Specific gravity	1.35-1.49
Viscosity (25% w/w solution, 20 °C Brookfield Viscometer)	Viscosity can vary between sources, and also depending on age, processing conditions, solution pH, and ionic composition. As concentration of the gum is raised, viscosity increases and transitions from Newtonian to non-Newtonian.

Table-2. Chemical Properties of Gum Arabic

Test	Result
Molecular Weight or Molar Mass	$\approx 0.25 \times 10^6$
Density	1.35-1.49
Melting Point	0 – 100° C
Boiling Point	> 250° C

Table-3. Pharmacopoeial standard of Acacia Gum

Sr. No.	Test	Observation and Results
1	Name / Synonyms	Acacia
2	Authorised Use	Excipient
3	Definition	specified
4	Identification	specified
5	Characteristics	specified
6	Starch, dextrin and agar	specified
7	Tannins	specified
8	Water Powdered Spray-dried	≤15.0%
9	Total ash	≤4.0%
10	Acid Insoluble matter	≤0.5%
11	Arsenic	≤3 ppm
12	Lead	≤0.001
13	Heavy metals	≤0.004%
14	Microbial contamination	specified

Peak List	Center	Area	Height	Left Edge	Right Edge
Peak1	668.931	0.000	3.166	665.330	665.330
Peak2	768.997	-0.076	0.012	765.968	758.513
Peak3	1013.845	-1775.347	15.479	1102.360	964.449
Peak4	1252.511	-64.372	1.499	1263.568	1220.703
Peak5	1369.530	0.172	0.007	1369.797	1356.751
Peak6	1412.322	-2.408	0.164	1414.525	1403.343
Peak7	1596.859	-126.055	4.401	1614.869	1580.391
Peak8	2363.923	0.513	0.206	2379.905	2366.860
Peak9	3242.086	0.000	0.134	3237.193	3237.193
Peak10	3366.067	0.000	0.119	3362.059	3362.059

Figure 2. FTIR Graphs calculation of Acacia

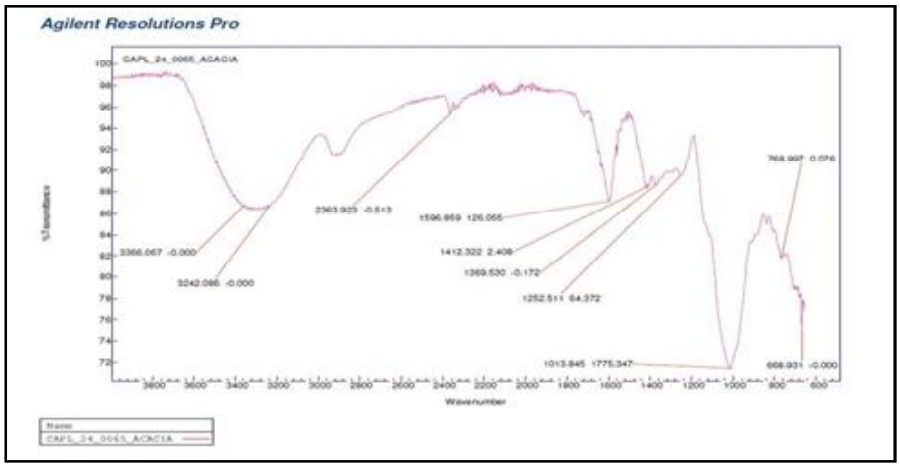

Figure 3. FTIR Graphs of Gum Acacia

Neem Gum

Table-4. Organoleptic Characteristics of the Neem Gum

S. No	Characteristics	Observation
1	Colour	Creamy whitish
2	Odour	Odourless
3	Taste	Mucilagenous
4	Shape	Irregular
5	Fracture	Irregular
6	Texture	Coarse

Table-5. Chemical test of the Neem Gum

Parameters	Tests	Observation of Neem Gum	Results
Carbohydrate	Molish Test	Formation of violetring at the junction	Presence of carbohydrate
Reducing sugars and aldehyde	Fehling's Test and Benedict's test	Formation of brick red colour	Presence of reducing sugar andaldehyde
Mucilage / Polysaccharide	Ruthenium Red	Formation of pink colour	Presence of mucilage poly saccharide
Starch	Iodine Test	No formation ofblue colour	Absence of starch
Alkaloid	Dragendroff's test	No orange red precipitate	Absence of alkaloid
	Mayer's test	No formation of white precipitate	
	Wagner's test	No reddish brown precipitate	

	Hager's test	No yellowprecipitate	
Glycoside	Keller killani test	No colour changewas observed at the junction	Absence of Glycoside
	Legal's test	No colour change	
	Baljet test	No colour change	
Phenols and Tannin	Ferric Chloride test	No colour change	Absence of phenols and tannin
	Lead acetate test	No precipitate was formed	
Steroids and sterol	Libermann Buchard's test	No colour change	Absence of steroids and sterol
	Salkowski reaction	No colour change	
Saponin	Foam Test	No formation of foam	Absence of Saponin
	Froth test	No formation of froth	
Proteins and Amino acid	Ninhydrin test	No colour change was observed	Absence of proteins and Amino acid
	Biuret test	No colour change was observed	
Flavanoids	Shinoda test	No colour change was observed	Absence of Flavanoid
	Alkaline reagenttest	No colour change was observed	
Terpenoid	Acetic anhydride test	No colour changewas observed	Absence of Terpenoid

Table-6. Solubility of Neem Gum

S. No.	Solvent	Solubility of Neem Gum
1.	Water	Partially soluble
2.	Water at 40°C- 70°C	Soluble
3.	Acetone	Insoluble
4.	Benzene	Insoluble
5.	Carbon tetrachloride	Insoluble
6.	Chloroform	Insoluble
7.	Cyclohexane	Insoluble
8.	Ethanol	Insoluble
9.	Methanol	Insoluble
10.	Acidic pH 1.2	Soluble
11.	Phosphate buffer pH 6.8	Soluble
12.	Phosphate buffer pH 7.4	Soluble

Table-7. Physiochemical Characterization of Neem Gum

S.No	Characteristics of Neem Gum	Observations
1.	Melting point (DSC)	319.8° C
2.	Average particle size (SEM)	43.42 µm-51.23µm
3.	Loss on drying	3±0.5%
4.	Total ash value	27.69 ± 0.10% at 398.6°C
5.	Water soluble ash	1.24±0.12%
6.	Water insoluble Ash	0.92±0.14%
7.	pH	7±0.2
8.	Swelling Index	13.9±0.13%
9.	Viscosity (10% w/v solution)	1150±1.14 cps

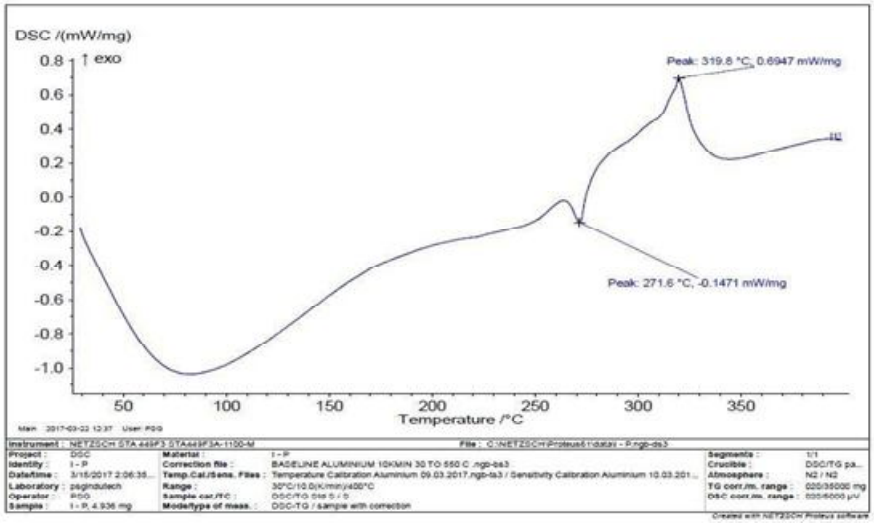

Figure 4. Melting point analysis by DS calorimetry of Neem Gum

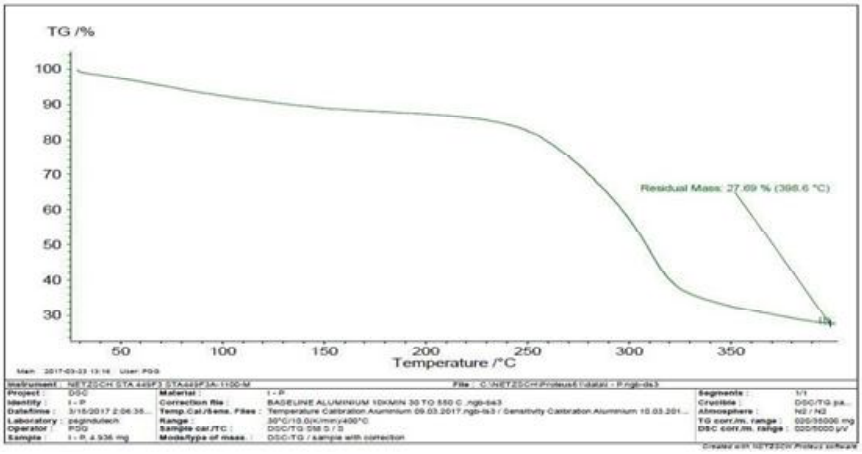

Figure 5. Thermo gravemetric analysis of Neem Gum

The melting point of dried Neem Gum was 319.8°C (Figure 8.1) indicated by a small endothermic peak on the DSC spectra and thermo gravimetric spectra, at this Neem Gum gets charred without melting because the same observation was made in melting point determination of gum powder with melting point apparatus. DSC thermogram and melting point value of the gum indicated the stability of the gum up to 300°C reflecting its high thermo stability and the gum could withstand heat generated during production processes.

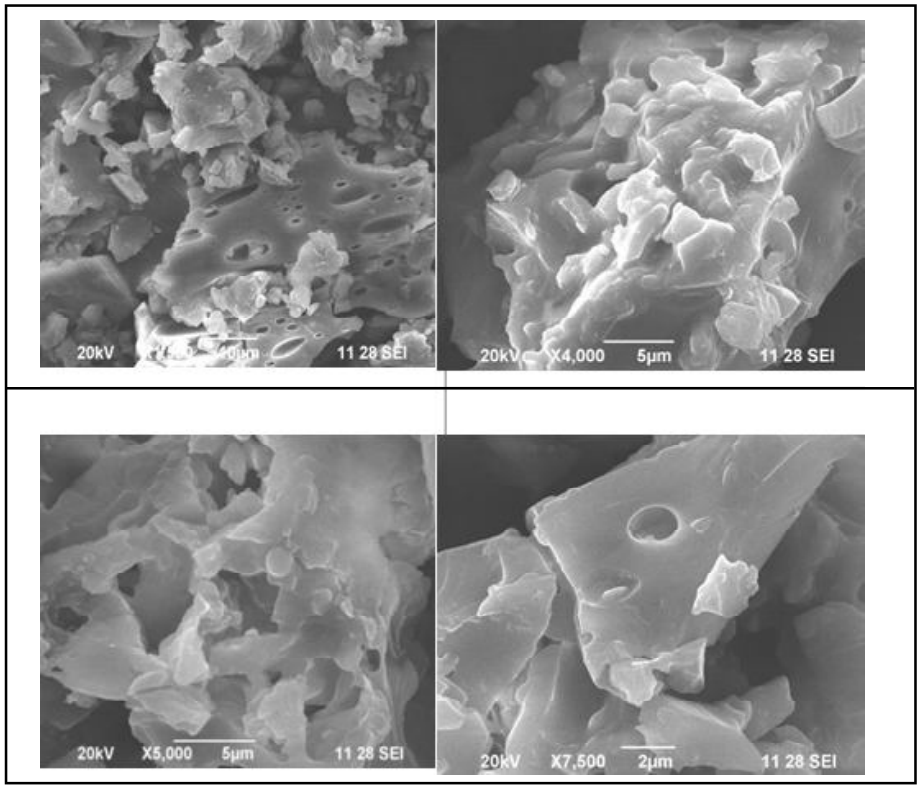

Figure 6. Scanning electron microscope image of the Neem Gum powder

dried gum has an average particle size range of 43.42 ±1 .12 to 51.23 ± 1.18 µm, the surface of the particles was found to be rough and irregular as shown in SEM photograph in different magnifications as represented in Figure.

X ray diffraction analysis is used for the identification of crystallinity (Polymorphism) and orientation of polymers. X ray diffraction pattern of crystalline solids will be indicated by well-defined edges and faces diffract X-rays and tend to have sharp melting points. In contrast, amorphous solids have irregular or curved surfaces and do not give well-resolved peak of spectrum. In figure 8.4 X-ray diffraction patterns of Neem Gum showed no significant sharp peaks which reveal the amorphous nature of the gum.

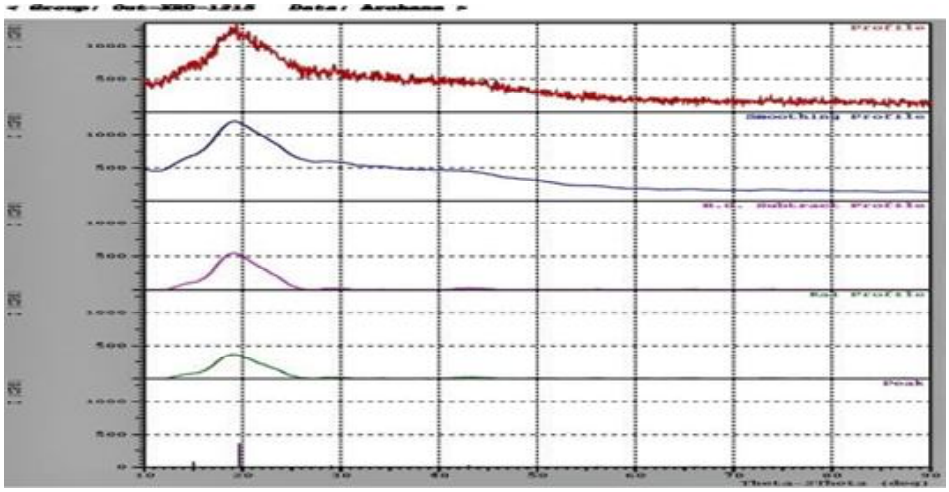

Figure 7. X-Ray diffraction Pattern of the Neem Gum

Table-8. Micromeritic characters of Neem Gum

S. No	Characteristics	Observations
1.	Angle of Repose	49°2" ±2°14"
2.	Bulk density	0.53±0.12 gm/cc
3.	Tapped Density	0.70±0.16 gm/cc
4.	Carr's Index	24.28±2.42%
5.	Hausner ratio	1.32±0.39

Peak List	Center	Area	Height	Left Edge	Right Edge
Peak1	778.766	-9.146	0.710	789.264	774.354
Peak2	855.637	-0.165	0.009	865.674	859.151
Peak3	969.194	-198.378	4.885	984.017	921.584
Peak4	1235.633	-186.552	4.711	1257.045	1212.317
Peak5	1313.687	-34.298	1.569	1325.069	1296.182
Peak6	1369.578	-1.318	0.010	1369.797	1356.751
Peak7	1609.110	0.000	0.170	1612.074	1612.074
Peak8	1735.045	-17.805	1.334	1757.440	1730.417
Peak9	2930.258	-427.874	5.286	2964.165	2859.800
Peak10	3268.577	-1.611	0.210	3272.603	3259.557
Peak11	3360.120	0.000	0.239	3354.604	3354.604

Figure 8. FTIR Calculation of Neem Gum

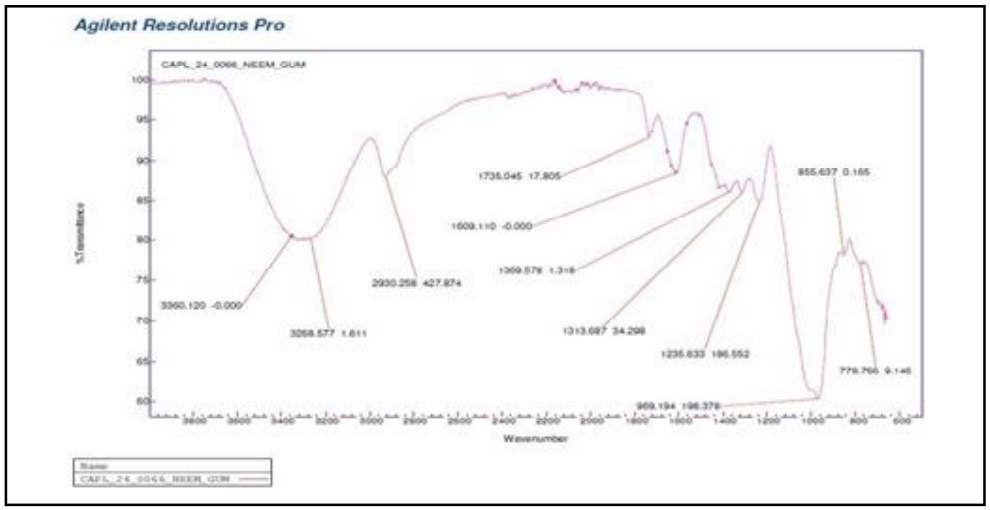

Figure 9. FTIR Graphs of Neem Gum

The physicochemical characterization of the *Acacia* gum revealed that tannin and dextrin are absent in the gum, and the moisture content and ash values were within the pharmacopeial limit. The gum was also found to be soluble in cold and hot water but insoluble in organic solvents and exhibited excellent flow-ability and compressibility. The oral acute toxicity study in mice showed that the gum is safe up to 5 g/kg body weight.

In the pharmaceutical industry, *Acacia* functions as emulsifying agent, thickener/ viscosity-increasing agent, and binder, especially in buccal or lozenge type dosage forms. Acacia powder hydrates readily in cold water and concentrations of up to 40-50% can be handled easily. Unlike other water-soluble gums of similar molecular weight, Acacia gums exhibit very low viscosity in water. For instance, a 1% dispersion of Xanthan gum yields a viscosity of 3000-5000 mPa s whereas Acacia needs a 40% concentration to achieve similar viscosity. For this reason, when used in oral and topical pharmaceutical formulations as a suspending and emulsifying agent, acacia is often combined with other gums or thickeners.

It is also used in the preparation of buccal tablets (pastilles and lozenges), and rarely as a tablet binder especially if a prolonged disintegration time is desired. It is used to stabilise oil emulsions and can be added into tablet coating formulations. At 1% Acacia gum can be used as a basis for formulating chews (hard sweets/lozenges). Acacia is also used in topical products and cosmetics as an alternative to synthetic emulsifiers, stabilisers and thickeners.

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