**Journal of Textiles, Coloration and Polymer Science**

**https://jtcps.journals.ekb.eg/**

# Psyllium Seeds, Sage Seeds, Rocket Seeds as A Sources of Galactomannan Gum

**Ahmed G. Hassabo [a]*, Nehad Z. Gouda [b], Neaama A. Abd El-Salam [b], Nourhan A. Mohamed [b], and Hanan A. Othman [b]**

[a] *National Research Centre (Scopus affiliation ID 60014618), Textile Research and Technology Institute, Pretreatment and Finishing of Cellulose-based Textiles Department, 33 El-Behouth St. (former El-Tahrir str.), Dokki, P.O. 12622, Giza, Egypt*

[b] *Benha University, Faculty of Applied Arts, Printing, Dyeing and Finishing Department, Benha, Egypt*

**Abstract**

THE process of printing involves applying colour to only a portion of the fabric rather than the full thing. The multicoloured designs that emerge offer lovely and artistic effects, elevating the fabric's worth above that of plainly dyed fabric. Synthetic thickeners used in the printing industry have a number of detrimental environmental effects. Because of this, we focused on using several environmentally friendly natural gums as thickeners in this study to lessen the influence on the environment, such as those derived from sage seeds (SSG), psyllium seeds (PSG), and rocket seed oil products (RSG). The findings of this study suggested that it would provide a fresh viewpoint for enhancing the value of by-products such sage seed, psyllium seed, and rocket seed oil.

**Keywords:** Natural gum, Thickener, Rocket seed gum, Sage seed gum, Psyllium seed gum.

## Introduction

As it allows for creative and new modifications in clothing in terms of colour, pattern, and style, printing plays a significant part in resurrecting traditional art forms. Every printing technique needs a paste or thickening agent with unique properties known as the flow characteristics. There are many different types of thickening agents. Due to their biocompatibility, low toxicity, environmental "friendliness," and lower cost as compared to synthetic items, plant products are appealing substitutes for synthetic ones. [1, 2]

In general, gum and starches derived from natural resources are non-polluting renewable sources for a sustainable supply. Plant-based natural gums and starches have a variety of uses in the wet processing of textiles. Any gum's use mostly depends on its viscosity, which varies greatly depending on the source's unique physical, chemical, and fine-grained characteristics.

The quest for locally accessible materials that are suitable to be utilised as an alternative to the traditional thickeners is prompted by the rising demand, high cost, and scarcity of natural thickeners. Different thickening agents based on starch, including modified starch, CMC, PVA, and sodium alginates, are frequently utilised. Alginates from various salts can be utilised in all types of dye products, but their cost is higher and their yield is insufficient. Due to its high cost, CMC is also only occasionally employed in textile printing. The quest for locally accessible materials that are suitable to be utilised as an alternative to the traditional thickeners is stimulated by the rising demand, high price, and scarcity of natural thickeners.

Being more conscious of these Intermediates and chemicals used in synthetic dyes Due to their toxicity and threat to both human health and the environment, non-toxic environmentally friendly colouring products have gained popularity once again. Numerous studies on colour extraction currently exist. Flowers, barks, fruits, and other naturally occurring dyeing materials can be used successfully to dye fabrics. One of the most significant agricultural compounds utilised in a variety of global sectors is seed gum. expanding market A thorough search for new sources of gum-

*Corresponding author: Ahmed G. Hassabo, e-mail: aga.hassabo@hotmail.com, Tel. 01102255513
(Received 02/1/2023, accepted 15/1/2023)
DOI: 10.21608/JTCPS.2023.185127.1154

modified goods was prompted by the usefulness of this glue in the paper, textile, petroleum recovery, and pharmaceutical industries. For usage in printing on fabric, the researcher is using a novel natural gum made from watercress seeds, sage, and psyllium in the current work. [2]

**Natural gums**

**Rocket seeds gum**

Lifelong herb Eruca sativa, also known as "rocket," is cultivated in southern Europe and India. It belongs to the Brassicaceae family. For a long time, salads have been made with ingredients from rocket plants.

Numerous phytochemicals that are good for your health can be found in rocket seed (Eruca sativa), including fibre, polyphenols, and glucosinolates. Due to its high oil content (20.0%) and the usage of erucic acid in the creation of a variety of industrial goods, including as plasticizers, surfactants, detergents, coatings, and polyesters, it has been utilised in the oil production industry. [3]

The rocket seed has a sizable quantity of protein (31.0%), crude fibres (20.4%), and total carbohydrates (23.1%) [15]. Due to their high protein and carbohydrate content, rocket seeds have a good amount of gum and exceptional functional qualities. Due to the high carbohydrate (80.38%) and low protein (5.81%) contents of rocket seed gum (RSG), the purification technique employed to obtain gum may be appropriate. Gum's protein content is a key factor in affecting its ability to create an emulsion, foam, and films. When compared to other commercial gums, RSG had a greater protein level than xanthan gum (2.125%), a lower protein content than guar gum (8.19%), and a protein content that was comparable to locust bean gum (5.2–7.4%). [4]

**RSG Extraction**

In a magnetic heating stirrer at 80 1.0 °C for two hours, the Rocket seed gum was extracted with distilled water (water: seed ratio of 20:1) and the seeds. By absorbing water, rocket seeds expand, and the granules release the gel structures. The solution produced by the extraction was mixed with 5000 mL of water. The mixture was thinned out. Filtration was used to remove the rocket seeds, which dilution causes to sink to the bottom.

The separated solution was concentrated by evaporating in an evaporator at 80 °C for three hours in order to remove water from the structure, and dilution was made by adding ethyl alcohol (96%) in a ratio of 1: 2 (h: h) to the solution. Alcohol caused the gum in the solution to rise due to the difference in densities and accumulate on the surface. The surface-collected gums were placed in a container and dried for a day at 50°C in the oven. RSG was milled and sieved using a mesh 18 sifter after drying.[3]

**Extraction of rocket seeds by solvents**

The seeds were cleaned at room temperature, they were transferred into mortar and crushed with a pestle. Then seeds made into powder to be ready for extraction and analysis. 25 gm of seeds were weighed and transferred into thimble and transferred to Soxhlet extractor. 250 ml of n-hexane were added into the flask. The temperature was set at 60C0. The process was carried out for 6 hours. n-hexane was evaporated using rotary evaporator then extracted oil was kept for analysis. [5]

**Physicochemical Properties**

In Table 1, the chemical makes up of RSG were listed. RSG had 80.38% carbohydrate, 5.81% protein, 10.26% moisture, and 3.55% ash, respectively. reported that the mucilage from rocket seeds includes no fat, 12.28% moisture, 10% ash, 9.75% protein, and 67.97% carbohydrates. The pH of RSG was found to be 5.71. n. Table 1 also indicates the sugar composition of the RSG.

RSG has a high carbohydrate content (80.38%) and a low protein content (5.81%), making the purifying process used to extract gum suitable. Although the carbohydrate content of RSG (80.38%) was higher than that of guar gum (71.1%), it was less than that of Soymida febrifuga exudate gum (88.77%) and comparable to Descurainia sophia seed gum (78.23%).

When compared to other commercial gums, RSG had a greater protein content than xanthan gum (2.125%), a lower protein content than guar gum (8.19%), and a protein content that was comparable to locust bean gum (5.2-7.4%). [3] Table (2) compares some of the physical and chemical characteristics of rocket seed oil to those determined for corn and sunflower oils; likewise cottonseed oil.[6]

**Table 1**. The chemical composition of the RSG.

| Seed Composition (w/w %) | | Sugar composition (w/w %) | |
|---|---|---|---|
| Carbohydrate | 80.38±1.13 | Galactose | 24.49±0.74 |
| Protein | 5.81±0.26 | Mannose | 37.29±0.32 |
| Moisture | 10.26±0.19 | Glucose | 9.89±0.05 |
| Ash | 3.55±0.04 | Fructose | 11.59±0.11 |
| | | Arabinose | 13.28±0.23 |

Table (2): Some Physical and Chemical Properties of Rocket Seed Oil Compared with Sunflower, Corn and Cottonseed Oils.

| Oil / Properties | Rocket Seed Oil* | Corn Oil* | Sunflower Oil* | Cottonseed Oil** |
|---|---|---|---|---|
| Specific gravity (25 ºC) | 0.8960 | 0.9173 | 0.9200 | 0.9170 |
| Refractive index (25 ºC) | 1.412 | 1.465 | 1.470 | 1.470 |
| Saponification value (mg KOH/g oil) | 162.98 | 191.35 | 210.44 | 213.88 |
| Iodine value (g I/100 g oil) | 134.35 | 118.40 | 130.07 | 102.15 |
| Acid value (mg KOH/g oil) | 2.25 | 0.28 | 0.48 | 0.43 |
| Free fatty acids (as % Oleic) | 1.13 | 0.14 | 0.24 | 0.22 |
| Peroxide value (meq. $O_2$ /kg oil) | 0.71 | 0.00 | 0.00 | - |

**Steady Shear Rheological Properties of the RSG**

Figure 1 depicts the viscosity and flow characteristics of RSG solutions at various concentrations (0.2-1.0% w/v) with shear rates ranging from 0.01 to 100 s-1. Figure 2a shows that at all concentrations, the RSG samples' viscosity reduced as the shear rate increased. As molecular bonds broke down as shear rate increased, molecules became more regular and internal friction decreased. RSG solutions' viscosity decreased as a result. RSG solutions at all concentrations exhibited non-Newtonian shear-thinning flow behaviour, as seen by the reduction in viscosity caused by an increase in shear rate (Figure 1b).[3]

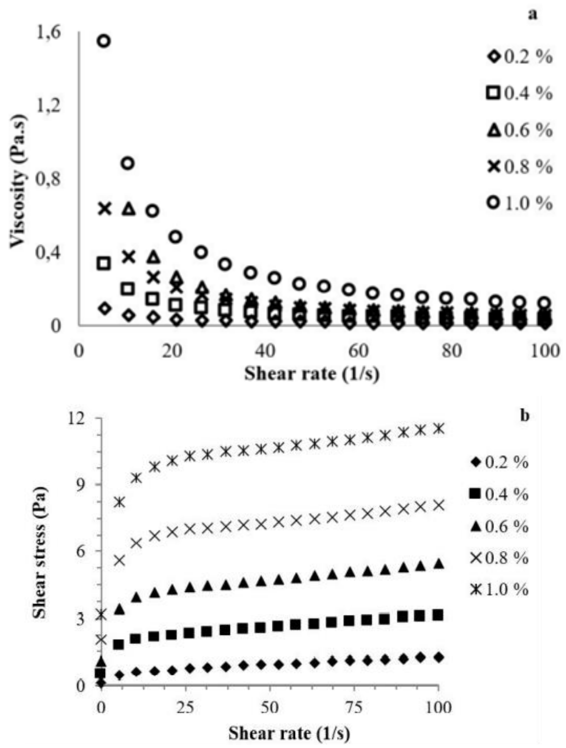



Figure 1 shows the viscosity and flow behaviour characteristics in relation to the shear rate at various RSG solution concentrations. Shear rate vs viscosity as seen on the surface, and shear rate versus shear stress.

**sage seeds gum**

Native to the northern Mediterranean shore is salvia. It is widely cultivated and widely dispersed, and it can survive up north into Canada. Salvia is derived from the Latin salvere, which means to salvage and is related to salus (health, well-being, prosperity, or salvation); referring to the medicinal benefits of the herb. [7]

With between 700 and 900 species of shrubs, herbaceous perennials, and annuals, Salvia is the biggest genus of plants in the Lamiaceae (mint) family. It belongs to one of numerous genera that collectively go by the name sage and is used in a variety of ways, including as a dye, preservative, decorative, cosmetic, and culinary ingredient. Sage is a natural preservative for meat, poultry, fish, and sauces due to its antimicrobial characteristics.

In addition to its application in meals and cosmetics, sage seeds can be utilised as a new substitute for hydrocolloid, a thickening agent, a fat substitute, and a stabilizer . [8]

Sage seed gum's (SSG) physicochemical, functional, and rheological properties, as well as extraction optimization, have all lately been thoroughly studied.

The SSG was identified as a galactomannan with a mannose/galactose ratio of 1.78-1.93, an average molecular weight of 1.5 × 106 Da, and a uronic acid content of (28.2-32.2)%.Basedon these characteristics, the SSG can be employed to create biodegradable films with good thermal stability and polar solvent solubility.[7]

**Extraction of sage seeds gum**

The sage seeds (Salvia macrosiphon) came from an Iranian herbalist's shop in Mashhad. Using a blowing apparatus, the seeds were subjected to a blowing procedure to remove extraneous substances including dirt, debris, and wood. The cleaned seeds were maintained in a dry, cool atmosphere after being packaged in plastic.[9]

**Wet extraction method (WEM)**

Sage seed gum was extracted aqueously under ideal conditions (51:1 water to seed ratio; 25°C; 5.53 pH). Using this technique, a 0.1 molar solution of sodium hydroxide and hydrochloric acid was used to change the pH. A water bath system was in place to control the temperature. 40g of seed and 1000 ml of water were combined to obtain the desired ratio, and the mixture was agitated in a water bath for 20 minutes to allow for complete water absorption. Then gum was extracted from swollen seeds using a laboratory extractor apparatus. The crude extract was then collected, put through a vacuum filter to eliminate impurities, and dried at 70°C in an oven. The dried SSG was then ground in a ball mill and filtered through sieves with an 80-micron mesh size.

**Dry extraction method (DEM)**

The seeds entered the space between the two rough metal surfaces from the entrance (Fig.1). While the lower level (G) is immobile, the upper level (C) can rotate. An adjustment screw regulates a significant variable, the distance between the two abrasion surfaces. The device's rate of seed output is controlled by the angle between the abrasion surfaces and horizon, which was the other controlling factor. The abrasion between the seed and the surfaces causes the dehulling of seeds, which can be controlled by changing the aforementioned variables. The rotor speed of 900 rpm, the abrasion angle of 6.9°, and the gap size of 2.2 mm were used based on the dry method's optimal parameters to get the best extraction yield, lowest protein level, and highest apparent viscosity (in an aqueous solution): The ground material was then screened with a blower to create the gum powder. The resulting gum was then ground into a powder using a ball mill and filtered using an 80-micron mesh sieve.[9]

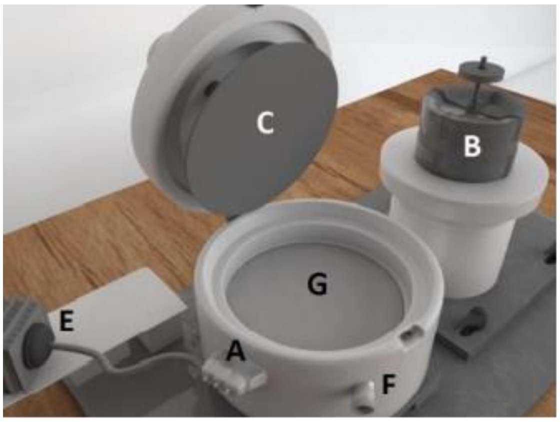



Fig. 1. Dry-based extractor designed for separation of the mucilage from the mucilaginous seeds: (A) Feed inlet, (B) Rotor, (C) Mobile abrasion surface, (E) Air compressor, (F) Outlet, (G) Stationary abrasion surface.

**Physicochemical Properties**

The chemical compositions (moisture, total protein, total ash, minerals, total carbohydrate, total uronic acids), rheological qualities, and surface activity of sage seed gum (SSG) were determined. Additional structural details about the polysaccharide gum were also revealed by FTIR analysis and molecular weight metrics. The SSG had an average of 69.01% (d.b.) carbohydrates, 2.08% (d.b.) protein, 9.20% (d.b.) ash, 11.24% (w.b.) moisture, and 30.2% uronic acids. With the exception of potassium, which was higher in SSG, the mineral content of SSG was comparable to that of commercial gums. The 1.78:1.93 mannose/galactose ratio and weight average molecular weight of the SSG polysaccharide, as determined by the chromatographic and FTIR investigations, are indicative of a galactomannan. Although SSG had a smaller molecular weight and gyratory radius than guar gum, the inherent viscosity values were the same. SSG showed stronger shear-thinning behaviour and a typical weak gel characteristic during steady and dynamic shear tests, respectively, than other commercial gums. The SSG polymer's FT-IR spectra revealed the presence of carboxyl groups, which could act as ion-binding sites. SSG showed a tendency to lessen water's surface tension at concentrations lower than 0.25%. The current work adds fresh knowledge about sage seed gum that is essential for illuminating its exceptional functional characteristics.[10]

Table 1. Chemical compositions (%, w.b.) and extraction yield (%) of sage seed gum derived by wet extraction (WEM-SSG) and dry extraction (DEM-SSG) methods.[9]

| Composition | WEM-SSG | DEM-SSG |
|---|---|---|
| Moisture | 7.61±0.11[a] | 7.64±0.23[a] |
| Ash | 8.69±0.25[a] | 4.11±0.16[c] |
| Protein | 3.21±0.09[c] | 7.02±0.43[b] |
| Fat | 0.97±0.03[c] | 10.41±0.59[a] |
| Carbohydrate | 77.21±1.89[a] | 68.74±2.30[b] |
| Extraction yield | 9.52±0.41[b] | 10.61±0.56[a] |

**Steady Shear Rheological Properties of the SSG:**

In a shear stress range of 0.01 to 150 Pa, Figure 1 displays the values of the linear viscoelasticity moduli, G′ and G″, as a function of shear stress. These values were acquired from a stress sweep done at a fixed frequency (1 Hz) and temperature (20°C). As can be seen, each SSG sample exhibits an initial linear viscoelastic zone where the stress has no effect on either of the linear viscoelastic moduli. The extension of the linear viscoelastic regime and the stress dependence in the nonlinear zone are two additional effects of gum concentration that are shown in Figure 1. Lower stress values must be obtained in order to guarantee linear viscoelastic characteristics because the SSG samples showed a larger dependence on stress amplitude at lower concentrations. In general, G′ did not abruptly alter until a stress amplitude of 0.33 Pa at a concentration of 0.5%. As a result, the 1% strain used in the frequency sweep testing was well within the LVR and did not cause any harm to the gel network. Over the full range of stresses, the storage modulus was always roughly two orders of magnitude bigger than the loss modulus, suggesting the presence of a storage modulus.[11]

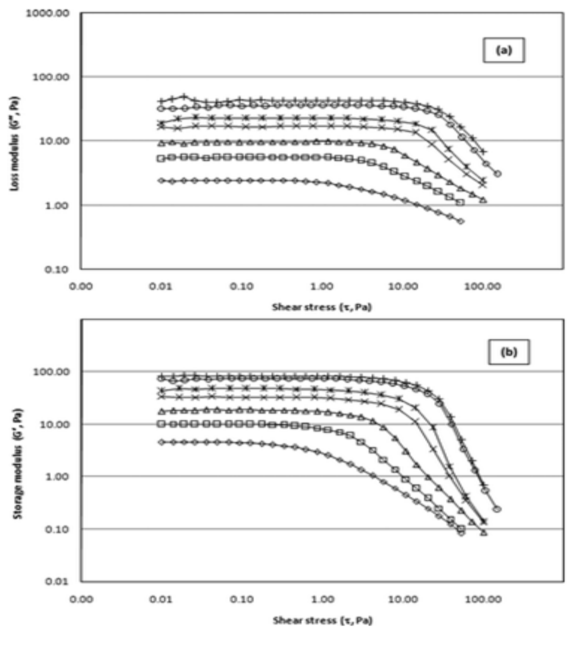
Figure 1 Stress dependency of sage seed gum's loss modulus and storage modulus at various concentrations (1 Hz, 20°C) (a, 0.5%; b, 0.75%; c, 1%; d, 1.25%; e, 1.5%; f, 1.75%; +, 2%).

**psyllium seed gum**

The plantago ovata is a member of the Plantaginaceae family, also known as Psyllium. It is a significant commercial crop grown in Pakistan, India, and Iran. Plantago's isabgol seed, which resembles a "horse ear," is where it gets its name. Originally from West Asia, the plantago ovata was brought to India during the Mughal Empire in the middle centuries. 1,3 The top four states for psyllium production are Gujarat, Madhya Pradesh, Rajasthan, and Haryana. India produces 98% of the world's psyllium husk and exports it.[12, 13].

The concave side of the psyllium seeds has a thin white papery coating that allows the outer layers of the ovule to fuse with the inner epidermis to create the seed coat or husk. Husk, which has been used for medicinal purposes and is odourless and tasteless, is removed from the seed by mechanical grinding and can yield up to 26%.

The alkali extractable polysaccharides' gel-forming portion is made up primarily of arabinose, xylose, and traces of other sugars. When wet, they expand and turn mucilaginous. They are soluble in water. Commercial mucilage manufacturing uses seeds to produce mucilage. It is a hydrophilic white fibrous substance that, when exposed to water, transforms into a transparent, colourless mucilaginous gel. N, N methylenebisacrylamide was used as a crosslinker and ammonium persulfate (APS) was used as an initiator for model medicines in the successful evaluation of psyllium seed husk as a binder, disinter grant, release retardant, and pH sensitive new hydrogels .[13].




**Composition and Structure of Psyllium Husk**

Table 1 displays the chemical make-up of the psyllium husk that was the subject of this article. The primary ingredients of psyllium husk are xylose and arabinose, which have the largest content. Notably, uronic acid, which has good antioxidant qualities and may scavenge free radicals, is also present in psyllium husk at a specific quantity. [14, 15].

Figure 1 depicts the psyllium husk's molecular composition. It is a highly branched arabinoxylan with a (1 4)-d-xylose main chain structure with side chains at C-3 and C-2. In order to increase the rigidity of the molecular main chain and the steric effect between branched chains, which improves the polymers' resistance to temperature, it has been shown that the presence of branched chain structures is more advantageous. In the meantime, its useful component, uronic acid, may efficiently remove oxidation groups from polymers and prevent their oxidative breakdown. As a result, the presence of uronic acid will effectively block the intensification of molecular thermal motion and acceleration of the oxidative degradation rate of the polymer as temperature rises. The degree of the polymer's branched chain structure will also deepen as a result of the molecular chain breaking as the temperature rises. As a result, the rigidity of the molecular main chain continues to increase, and the steric effect between the branched chains also increases the molecular chain's resistance to thermal decomposition.[14].

**Table 1. Composition of Psyllium Husk**

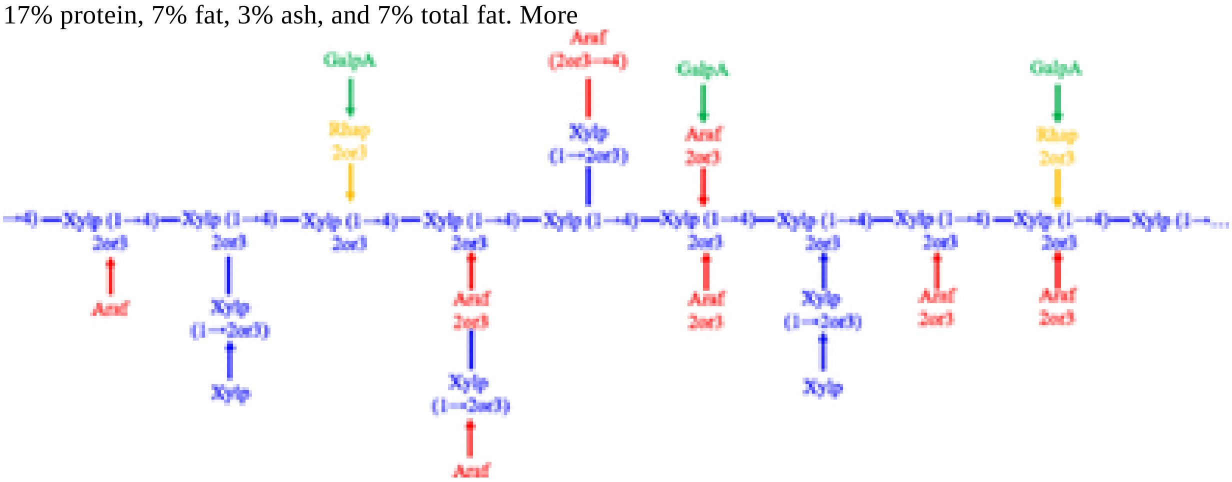
| composition | relative content/(w/v %) |
|---|---|
| arabinose | 21.4 |
| xylose | 75.4 |
| galactose | 1.6 |
| glucose | 0.6 |
| rhamnose | 0.3 |
| uronic acid | 0.7 |

**Extraction of psyllium seeds gum**

In order to reduce the size of the dried Psyllium seed husk, it was crushed in a mortar and pestle. Weighed amounts of fine powder were then combined with distilled water to create a slurry. The slurry was allowed to cool to room temperature after being placed into an adequate amount of boiling distilled water. The residue was sequentially cleaned with petroleum ether, diethyl ether, and acetone after the supernatant had been separated by centrifugation. Additionally, precipitate was vacuum-dried at 50–60°C to eliminate volatiles and moisture. To obtain a homogeneous particle size range, the dried material was further ground and sieved. [16].

**Physicochemical Properties**

Psyllium seeds have an ovoid-oblong form, a pink grey to brown tint, and a length and breadth of 2 to 3 mm and 0.8 to 1.5 mm, respectively. Psyllium seeds weigh between 0.1 and 0.2g per 100 seeds. Psyllium seed has a composition of 49% total carbohydrates, including 25% total dietary fibre, 17% protein, 7% fat, 3% ash, and 7% total fat. More than 60% of the psyllium husk is made up of arabinoxylans, the most prevalent polysaccharide in psyllium being complex heteroxylans, which are composed of the monosaccharide units of arabinose and xylose. Psyllium seeds include a wealth of phenolics, flavonoids, antioxidants, and sulfur-containing amino acids.[13].



In terms of pH, it was discovered that psyllium gels exhibit their greatest functional qualities between pH 4 and pH 7. It can be explained by the fact that at low pH levels, net electrostatic repulsion diminishes and molecular interaction also declines, both of which cause a fall in gel flexibility. In addition, an alkaline depolymerization reaction that produces fewer junction zones may be to blame for the decreased gel elasticity in environments with higher pH values. [17].

**Rheological Property Measurement**

The rheological curve for the bentonite-based slurry after adding psyllium husk of various grades is depicted in Figure 1. We can infer that there is shear thinning in the psyllium husk suspension. The viscosity of the psyllium husk suspension decreases with an increase in shear stress as the shear rate rises. When the shear rate is low, the psyllium husk will absorb a lot of water molecules, making the drilling fluid more viscous and helping to transport cuttings as the drilling fluid circulates. The aggregation of polymer chains diminishes, polymer molecules shift in the direction of flow, and the viscosity of the drilling fluid lowers, all of which are more advantageous to the drilling process as the shear rate rises.[18].

**Comparison between gums extracted from psyllium seeds, sage seeds, and Rocket seeds:**

Table 1 shows the differences between the gum of rocket, sage, and psyllium seeds in terms of chemical and physical properties, pH value, and uses.Where the rocket seeds showed that the pH value is 5.71 and can be used in plasticizers, surfactants, detergents, and coatings, and it has been used in the oil production industry. As well as the pH spectrum of sage seed gum (5.6-7.8) and in psyllium seeds ranged between pH spectrum (4-7).

**Summary**

In this investigation, chewing gum was made using psyllium, sage, and watercress seeds. The research revealed that RSG has a high carbohydrate content (80.38%) but a low protein content (5.81%). Mannose and galactose are also abundant in it. The mannose/galactose ratio of SSG is 1.78–1.93, and it contains 28.2–32.2% uronic acid. These characteristics allow SSG to be employed to produce biodegradable membranes with good thermal stability and polar solvent solubility. Psyllium seeds, on the other hand, are oblong, pinkish-gray to brown in colour, and contain 49% total carbohydrates, including 25% dietary fibre, 17% protein, 7% fat, 3% ash, and 7% total fat. Psyllium seeds are a rich source of phenols, flavonoids, antioxidants, and amino acids that contain sulphur.

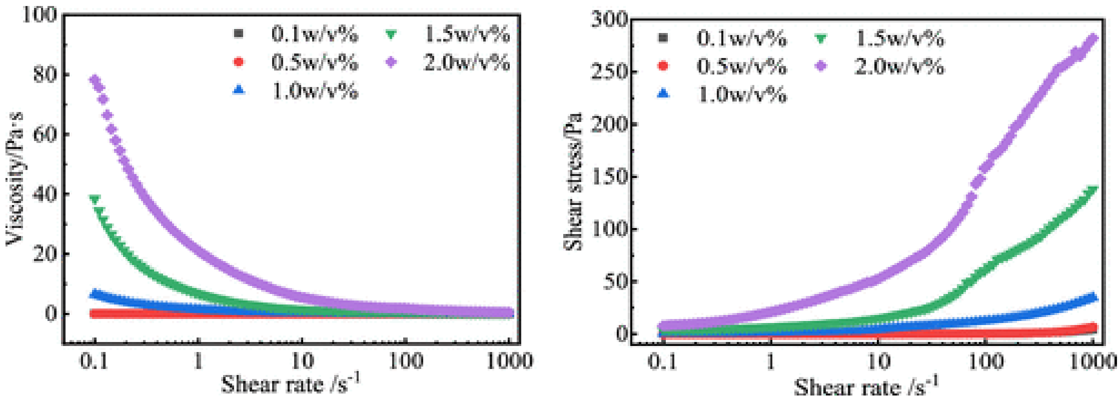



Figure 1 Effect of concentration on rheological properties of psyllium husk solution.

Table1: Differences between rocket seeds gum, sage seeds gum and psyllium seeds gum:

| | rocket seeds gum | sage seeds gum | psyllium seeds gum |
|---|---|---|---|
| Name | Lifelong herb Eruca sativa, also known as "rocket," is cultivated in southern Europe and India. It belongs to the Brassicaceae family. | Native to the northern Mediterranean shore is salvia. It is widely cultivated and widely dispersed, and it can survive up north into Canada. | The plantago ovata is a member of the Plantaginaceae family, also known as Psyllium. It is a significant commercial crop grown in Pakistan, India, and Iran. |
| uses | It is used to create a variety of industrial goods, including plasticizers, surfactants, detergents, coatings, and polyesters, and has been used in the oil production industry. | is used in a variety of ways, including as a dye, preservative, decorative, cosmetic, and culinary ingredient. Sage is a natural preservative for meat, poultry, fish, and sauces due to its antimicrobial characteristics. | Commercial mucilage manufacturing uses seeds to produce mucilage. It is a hydrophilic white fibrous substance that, when exposed to water, transforms into a transparent,colourless mucilaginous gel. |
| Physicochemical Properties | the chemical makes up of RSG were listed. RSG had 80.38% carbohydrate, 5.81% protein, 10.26% moisture, and 3.55% ash, respectively. reported that the mucilage from rocket seeds includes no fat, 12.28% moisture, 10% ash, 9.75% protein, and 67.97% carbohydrates. | The SSG had an average of 69.01% (d.b.) carbohydrates, 2.08% (d.b.) protein, 9.20% (d.b.) ash, 11.24% (w.b.) moisture, and 30.2% uronic acids. With the exception of potassium, which was higher in SSG, the mineral content of SSG was comparable to that of commercial gums. The 1.78:1.93 mannose/galactose ratio and weight average molecular weight of the SSG polysaccharide, as determined by the chromatographic and FTIR investigations, are indicative of a galactomannan. | Psyllium seed has a composition of 49% total carbohydrates, including 25% total dietary fibre, 17% protein, 7% fat, 3% ash, and 7% total fat. More than 60% of the psyllium husk is made up of arabinoxylans, the most prevalent polysaccharide in psyllium being complex heteroxylans, which are composed of the monosaccharide units of arabinose and xylose. Psyllium seeds include a wealth of phenolics, flavonoids, antioxidants, and sulfur-containing amino acids. |
| ph | The pH of RSG was found to be 5.71. | pH spectrum( 5.6-7.8). | pH spectrum( 4-7). |

**Conflict of Interest**

There is no conflict of interest in the publication of this article.

**Acknowledgment**

The authors are gratefully thanks to National Research Centre, Giza, Egypt and Faculty of Applied Arts, Benha University

**Funds**

This research doesn't receive any fund

**References**

1. Ebrahim, S.A., Hassabo, A.G. and Othman, H., "Natural Thickener in Textile Printing (a Mini Review)". *Journal of Textiles, Coloration and Polymer Science*, **18**(1) 55-64 (2021)
2. Sudha, B., Rupali, G. and Latika, S., "Screen Printing with Tamarind Seed Gum on Cotton Fabric". *Asian Journal of Home Science*, **13**(1) 180-186 (2018)
3. Kutlu, G., Akcicek, A., Bozkurt, F., Karasu, S. and Tekin-Cakmak, Z.H., "Rocket Seed (Eruca Sativa Mill) Gum: Physicochemical and Comprehensive Rheological Characterization". *Food Science and Technology*, **42**(2021)
4. Hijazi, T., Karasu, S., Tekin-Çakmak, Z.H. and Bozkurt, F., "Extraction of Natural Gum from Cold-Pressed Chia Seed, Flaxseed, and Rocket Seed Oil by-Product and Application in Low Fat Vegan Mayonnaise". *Foods*, **11**(3) 363 (2022)
5. Dafalla, A.M.M., "Extraction and Determination of Physicochemical Properties and Characterization of Arugula (Eruca Sativa) Seed Oil". (2022)
6. Owon, M.A., Noaman, M.A., El-Din, N., Roushidi, M. and Osman, M.A., "Chemical and Technological Studies on Rocket (Eruca Sativa) Seed Oil: 1-Characterization of Rocket (Eruca Sativa) Seed Oil". *Journal of Food and Dairy Sciences*, **30**(1) 383-395 (2005)
7. Yekrang, J., Saghafi, R., Yousefi, A. and Ghaffari, F., "Sage Seed Gum as a Novel Source for Polysaccharide-Based Antibacterial Nanofibers: Physical, Chemical, and Rheological Characterization". *Journal of Industrial Textiles*, 15280837221093661 (2022)
8. Salehi, F. and Kashaninejad, M., "Kinetics and Thermodynamics of Gum Extraction from Wild Sage Seed". *International Journal of Food Engineering*, **10**(4) 625-632 (2014)
9. Hosseini, A.R. and Razavi, S.M.A., "Physico-Chemical and Rheological Properties of Sage Seed Gum Extracted by Dry Method in Comparison with the Conventional Method". *Journal of Food and Bioprocess Engineering*, (2022)
10. Razavi, S.M.A., Cui, S.W., Guo, Q. and Ding, H., "Some Physicochemical Properties of Sage (Salvia Macrosiphon) Seed Gum". *Food Hydrocolloids*, **35** 453-462 (2014)
11. Razavi, S.M.A., Taheri, H. and Sanchez, R., "Viscoelastic Characterization of Sage Seed Gum". *International Journal of Food Properties*, **16**(7) 1604-1619 (2013)
12. Sharma, D.R., Sharma, A., Kaundal, A. and Rai, P.K., "Herbal Gums and Mucilage as Excipients for Pharmaceutical Products". *Research Journal of Pharmacognosy and Phytochemistry*, **8**(3) 145 (2016)
13. Shah, A.R., Gour, V.S., Kothari, S.L., Sharma, P., Dar, K.B. and Ganie, S.A., "Antioxidant, Nutritional, Structural, Thermal and Physico-Chemical Properties of Psyllium (Plantago Ovata) Seeds". *Current Research in Nutrition and Food Science Journal*, **8**(3) 727-743 (2020)
14. Chen, X., Gao, X., Chen, J., Liu, Y., Song, C., Liu, W., Wan, Y., Kong, X., Guan, Y. and Qiu, Z., "Application of Psyllium Husk as a Friendly Filtrate Reducer for High-Temperature Water-Based Drilling Fluids". *ACS omega*, **7**(32) 27787-27797 (2022)
15. Cui, S.W., Wu, Y. and Ding, H., "The Range of Dietary Fibre Ingredients and a Comparison of Their Technical Functionality". *Fibre-rich and wholegrain foods: improving quality*, 96-119 (2013)
16. Patil, B.S., Mastiholimath, V.S. and Kulkarni, A.R., "Development and Evaluation of Psyllium Seed Husk Polysaccharide Based Wound Dressing Films". *Oriental Pharmacy and Experimental Medicine*, **11**(2) 123-129 (2011)
17. Noguerol, A.T., Igual, M.M. and Pagán, M.J., "Developing Psyllium Fibre Gel-Based Foods: Physicochemical, Nutritional, Optical and Mechanical Properties". *Food Hydrocolloids*, **122** 107108 (2022)
18. Guo, Q., Cui, S.W., Wang, Q., Goff, H.D. and Smith, A., "Microstructure and Rheological Properties of Psyllium Polysaccharide Gel". *Food Hydrocolloids*, **23**(6) 1542-1547 (2009)

## بذور السيليوم ، بذور المريمية ، بذور الجرجير كمصادر لصمغ الجالاكتومانان

**أحمد جمعه حسبو[١]*، نهاد جودة [٢]، نعمة عبد السلام [٢]، نورهان محمد [٢] ، حنان علي عثمان[٢]**

[١] المركز القومي للبحوث (ID Scopus ٦٠٠١٤٦١٨) ، معهد بحوث وتكنولوجيا النسيج ، قسم التحضيرات والتجهيزات للألياف السليلوزية - الجيزة - مصر

[٢] جامعة بنها - كلية الفنون التطبيقية - قسم طباعة المنسوجات والصباغة والتشطيب - بنها - مصر

*المؤلف المراسل: البريد الإلكتروني: aga.hassabo@hotmail.com*

**المستخلص**: تتضمن عملية الطباعة تطبيق اللون على جزء فقط من القماش بدلاً من الجزء الكامل. توفر التصميمات متعددة الألوان التي تظهر تأثيرات جميلة وفنية ، مما يرفع قيمة النسيج فوق تلك الموجودة في النسيج المصبوغ بوضوح. للمكثفات الاصطناعية المستخدمة في صناعة الطباعة عدد من التأثيرات البيئية الضارة. لهذا السبب ، ركزنا على استخدام العديد من اللثة الطبيعية الصديقة للبيئة كمكثفات في هذه الدراسة لتقليل التأثير على البيئة ، مثل تلك المشتقة من بذور المريمية (SSG) ، وبذور السيليوم (PSG) ، ومنتجات زيت بذور الجرجير (RSG). ). أشارت نتائج هذه الدراسة إلى أنها ستوفر وجهة نظر جديدة لتعزيز قيمة المنتجات الثانوية مثل بذور المريمية وبذور السيليوم وزيت بذور الجرجير.

**الكلمات المفتاحية:** صمغ طبيعي ، مثخن ، صمغ بذور الجرجير ، صمغ بذور المريمية ، صمغ بذور السيليوم.