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A review on garden cress seeds: Mucilage isolation methods, chemical constituents, pharmacological profile, and pharmaceutical application

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Abstract
Cress seed mucilage (*Lepidium sativum* L.), which is used in pharmaceuticals, has gained prominence in the growing trend toward using natural ingredients. The seeds are rich in protein, fat, calcium, iron and have high nutritional value. They are considered to be galactagogue, anticarcinogenic, antidiabetic, antiasthmatic and antidiarrheal. Leaves which showed that these are good source of macro elements like potassium, sodium, calcium and trace minerals like iron, magnesium and zinc. Mucilage has recently been discovered to be very appealing, interesting, and useful in the development of desired pharmaceutical dosage forms. Plant-based mucilage has a wide range of potential applications in drug formulations. *Lepidium sativum* Linn. is a mucilage-containing, fast-growing, edible annual herb. Its various parts (roots, leaves, and seeds) have been used to treat a variety of human ailments. In this review, we focused on the seed coat mucilage isolation methods, chemical constituents, pharmacological profile, and versatile application of *Lepidium sativum* Linn. by making careful references to previously published work.

Keywords: *Lepidium sativum*, pharmaceutical application, garden cress seeds, cress seed mucilage

Introduction
Brassicaceae is one of the largest plant families, containing approximately 300 genera and 1500 species of vegetable crops, medicinal plants, and food plants. The Brassicaceae family has 53 genera and 103 species in Egypt, the Most common of which are Anstatica, Arabis, Diplotaxis, Zilla, and Lepidium. The genus Lepidium contains a number of species that flourish in warm temperatures. The species of this family can be found all over the world, with the highest diversity in the Mediterranean, West and Central Asia, and parts of North America. *Lepidium sativum* Linn. (L. *sativum*) is an annual herb of the Brassicaceae family. In some locations, L. sativum is also known as garden cress, garden pepper cress, pepper grass, pepperwort, or poor man's pepper. L. *sativum* is known as Asaliyo or Chandrasoor in indigenous languages, and it is a significant medicinal crop in India. It has important scientific and therapeutic ramifications. It is a polymorphous species that is assumed to have originated mostly in the highlands of Ethiopia and yet in addition to Eritrea, it has been detected in India, North America, and portions of Europe. It is produced for seed production in Rajasthan, Gujarat, Madhya Pradesh, and Tamil Nadu, among other Indian states. It may be grown at any elevation and at any time of year, however the winter months are when it yields the most. They have a wide range of pharmacological properties, including binding, dissolving, suspending, emulsifying, and retaining properties in diverse pharmaceutical dosage forms [1].
Plant-derived gums and mucilage are hydrophilic and gel-forming in nature. They are a naturally occurring result of cell metabolism. Natural additives must be substituted for synthetic additives due to the recent trend toward the use of plant-based and natural products. Matrix controlled systems, film coating agents, buccal films, microspheres, nanoparticles, and viscous liquid formulations such as ophthalmic solutions, suspensions, and implants have all been studied using these plant-based polymers. Their application and effectiveness have been proven. These have also been utilised as viscosity enhancers, stabilisers, disintegrants, solubilizers, emulsifiers, suspending agents, gelling agents, and bio adhesives and binders in the dosage forms. Because they are biodegradable, plant-derived gums and mucilage meet many of the requirements for pharmaceutical excipients.

They are non-toxic, stable, easy to get, have less regulatory problems than synthetic counterparts, and are inexpensive; they can also be easily customised to match specific demands [2].

When the seeds are soaked in water, they absorb the moisture quickly and generate a sticky, flavourless material. The seeds are known to have a high molecular weight gum and a large number of mucilaginous chemicals [31].

As previously stated, the bulk of the extract is carbohydrate, with mannose being the primary sugar. (38.9%), arabinose (19.4%), galacturonic acid (8%), fructose (6.7%), glucuronic acid (6.7%), galactose (4.7%), rhamnose (1.9%), and glucose (1.9%) (1.0 percent). According to the sugar composition study, the M G ratio of L. *sativum* seed extract is much higher, at 8.2. The sugar content of seed gums determines how they operate, and replacement amounts are thought to cause changes in behaviour amongst gums. The macromolecular component has a 540 kDa molecular weight and a semi-rigid xanthan-like chain structure. It's remarkable shear thinning properties are due to the semirigid chain structure, which facilitates macromolecular entanglement. We've come because we're on the lookout for hydrocolloids with unique rheological properties [4].

Fig 1: Cress seed

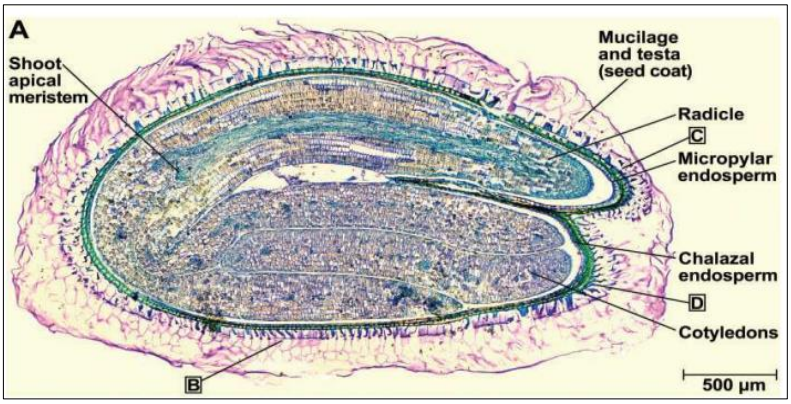

Fig 2: Shows the seed-covering layers' structure. Mucilage is produced by the outer testes [5].

Chemical constitutes

The seeds of L. sativum are strong in omega 3 fatty acids and contain around 21.54 percent oil (solvent extracted). Garden cress seed oil (GCO) is predominantly made up of linolenic acids (34%), as well as oleic acid (22 percent). GCO content of tocopherol and carotenoid is 327.42 mmol/100 g oil and 1.0 mmol/100 g oil, respectively. In 2010, Diwakar, Dutta, Lokesh, and Naidu published the phytosterol total Cress oil has a content of 14.41 mg/g of sitosterol, campesterol and avenasterol(Moseretal.,2009).Because its main component is natural, GCO is thought to be a fairly stable oil. (Diwakaretal.,2010)Tocopherol, phytosterol, and carotenoids are antioxidants that protect the oil from rancidity [7]. Blood pressure can be reduced by supplementing the human diet. The levels of cholesterol, triglycerides, alpha linolenic acid, and arachidonic acid in blood and hepatic tissues, as well as the conversion of linoleic acid to eicosapentaenoic acid, a long chain fatty acid, are all increased. Acid and docosahexaenoic acid levels in serum, liver, and cardiac tissue, as well as brain tissue. Flavonoids, alkaloids, glycosides, glucosinolates, sterols, tannins, and cardiotonic glycosides are all examples of phytonutrients. Triterpenes are phytochemicals present in a wide range of plants. Seeds of garden cress with therapeutic characteristics 2011. Furthermore, the seeds include Lepidine B, C, D, E, and F, as well as seven imidazole alkaloids (dimeric) lepidine A and B, and two unique numeric alkaloids [8]. L. sativum seed extract chemical composition, constituent sugars, and molecular parameters.

Table 1: L. *sativum* seed extract chemical composition and component sugars [9]

Chemical composition	Composition in (%)	Sugar contains	In (%)
Moisture	7.17	Man	38.9
Ash	11.5	Ara	19.4
Protein	2.45	Gla A	8.0
Fat	1.85	Fru	6.8
Sugar	77.03	Glu A	6.7
Ca	0.17	Gal	4.7
K	0.062	Rha	1.9
Na	0.039	Glu	1.0
Mg	0.0076	Total	87.4

Methods of extraction of cress seed mucilage

Method under optimal conditions

At 35°C, pH of 10, and a water-to-seed ratio (wt./vol) of 30:1, the method performed optimally. After 30 minutes, the mixture was blended to separate the slurry from the cress seeds. The solution was passed through a cheese paper to remove any impurities from the slurry. Before being used, the mucilage was freeze-dried and stored in a dry, cool environment [10].

Extraction of mucilage by using various Drying Method

CSG powder was produced, according to [4]. First, cress seeds were soaked in 30:1 distilled water for 30 minutes at 35 °C and pH 7. Following the soaking period, seeds were extracted from an extractor 700P, Rasht, and the surface of the gum layer was scratched with the extractor. After that, the

extracted cress seed mucilage was filtered and collected. In the following stage, the recovered mucilage was dried using several drying techniques [11].

Several drying methods were used to dry cress seed mucilage, including vacuum drying, freeze drying, and microwave drying. Samples were frozen at 20 degrees Celsius before being placed in a freeze dryer chamber (Model GTFD, Iran) at 40 degrees Celsius for the freeze-drying technique. In a vacuum dryer, the samples were dried at 40, 60, and 80 degrees Celsius (Vision scientific, Model VS-1202V5, Korea). The samples were microwaved for 50 minutes at 360 watts (model MS 93SCR, LG) [11]

Precipitation of soaked and blended seed in acetone

Wet and mixed seed acetone precipitation A total of 100g of seed was soaked in 800ml of distilled water for 12 hours. After that, pure the soaked seeds for 15 minutes at 2000 rpm with a Phillips HR 1453 hand blender. The contents of this mixer were filtered using a muslin cloth. To produce the best yield, 200ml extra water was added, stirred, and filtered through muslin fabric. For mucilage precipitation, this filtrate contains an equivalent quantity of acetone. Separate the white mass of supernatant using muslin cloth or filtration. Mucilage was precipitated and deposited on a glass slab, then dried for 16 hours in a tray drier at 60°C. Mucilage may be easily split into flakes by spraying acetone on a glass surface. The flakes were then dried for another 5 minutes at 60 °C [12].

Precipitation of soaked seed in alcohol

100 g of seeds were soaked in 1000 mL distilled water and 5 mL chloroform for 24 hours. The fluid that is viscous solution was filtered using a muslin towel. 95 percent ethanol in 1 litre of mucilaginous combination to precipitate the mucilage, precipitated mucilage was added. Mucilage was collected and dried at temperatures ranging from 40 °F to 45 °C until it was completely dry. The yield was calculated [2].

Extraction of cress seed mucilage

A seed purchased from a local market, washed them, and validated them from botanist. Mucilage may be easily removed from seeds because it swells when exposed to distilled water. As a result, the seeds were immersed in water for several hours. For 24 hours, 300 g of seeds were steeped in 300 mL of distilled water. The seeds created a clear watery capsule around it. The seeds were then stirred at 1,000 rpm using an overhead stirrer (Remi, Mumbai, India) to generate viscous fluid from the created capsule. The viscous fluid was then vacuum filtered with a pore size of 200 um. The seeds break away from the thick liquid. Ethyl alcohol, methanol, and acetone were utilised as precipitants for mucilage precipitation from viscous fluid solvents. These solvents were used ten times more than usual. the volume of a viscous fluid the solvent that precipitated the most mucilage was chosen [13].

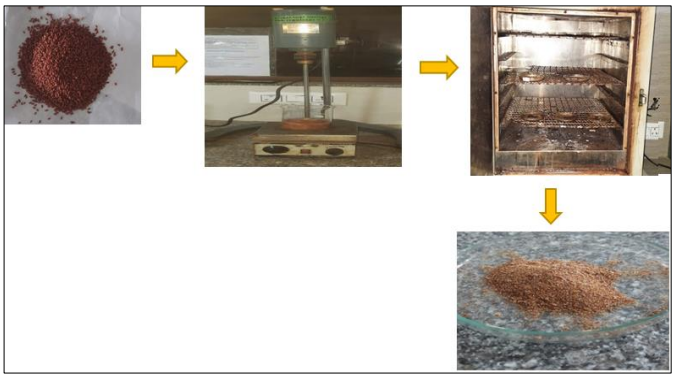

Fig 3: Extraction of mucilage by precipitation-soaked method

Physicochemical properties of cress seed mucilage

Morphology of cress seeds

Cress seeds are small, oval-shaped, with one end pointy and triangular, smooth, and reddish brown. Both sides have a furrow that extends up to two-thirds of the way down, and both seed edges have a wing like extension. Soaking seed coats in water causes them to swell and become covered in a clear, colourless mucilage with a mucilaginous taste. The seed length and width are 298 ± 3.2µm and 100 ±1.9 µm respectively [14].

Table 2: Physicochemical characterization [12].

Physicochemical characterization	Results obtained
Solubility profile of mucilage	slightly soluble in water, practically insoluble in ethanol, Methanol, acetone, ether, and benzene
Swelling index	11 ml
Loss on drying	3.96%
Total value	0.82%
Acid insoluble ash	0.23%
Water soluble ash	0.35%
Microbial load: bacteria (CFUs/g) fungi	97(CFUs/g)
(CFUs/g)	6(CFUs/g)
Density of powder:	
Bulk density (g/cc)	0.2857(g/cc)
Tapped density (g/cc)	0.3389(g/cc)
Compressibility Index	15.69%
Angle of repose	47.71°
pH	5.6
Extractive values	
alcohol soluble extractive value	13.36%
Identification tests: Mounted in 96% ethanol Mounted in Ruthenium red Mounted in iodine solution Test for carbohydrate (Mollish's test)	 Transparent angular masses Particles stained red Particles stained blue +

Test for tannins (Ferric chloride test) Test for sulphate (Barium chloride test) Test for chloride (Silver nitrate test)	- - -
Particle size:	1.3674 mm
length breadth	0.875mm
IR spectroscopy	Major peaks at 2924 cm^{-1} 1041cm^{-1} for hydroxyl group, 2858, 1234,1666 cm^{-1} for carboxyl group, 1604cm^{-1} for keto group

Zeta Potential Analysis for Surface Charge

The isolated biopolymer has a zeta potential of about 16 mV. This meant that the biopolymer's particle surface was negatively charged, which allowed its anionic nature to aid in flocculation by forming long linear chains to connect the particles [15].

Molecular weight

Cress seed mucilage has a molecular weight of 540 kDa and a gyration radius of 75 nm [16].

Table 3: Therapeutic applications of cress seed mucilage

Sr. No	Pharmacological activity of *Lepidium sativum*:	Description
1.	Antidiarrheal and antispasmodic activities	A methanolic (70%) seed extract of L. sativum at 100 and 300 mg/kg inhibits castor oil-induced diarrhoea in rats. It may have antidiarrheal and antispasmodic properties. are mediated on both sides by muscarinic receptor inhibition as well as Ca channel inhibition Similar results were discovered. To prevent diarrhoea, mice were given castor oil doses of 300 and 1000 mg/kg. Invitro Experiments with two distinct gut segments (ileum and jejunum) and jejunum) from three different species (rat, guinea-pig, and rabbit) revealed that the plant's antidiarrheal and antispasmodic activities are mediated via multiple pathways, including Ca antagonist, K channel opener, and PDE enzyme inhibition [17]
2.	Hypoglycaemic activity	The purpose of this study was to look into the anti-diabetic efficacy of L. sativum seed total alkaloid (LSTA). Lepidine and semi lepidine, a rare group of imidazole alkaloid, are the main components of this alkaoid fraction. The hypoglycemic profile of LSTA (50, 150, and 250 mg/kg, i.p.) was studied in alloxan-induced diabetic rats over a 21-day period. Glucose, total cholesterol, triglycerides, low-density lipoprotein, high-density lipoprotein, urea, and creatinine levels were measured, as well as body weight and relative organ weight. On the 21st day, LTSA at 250 mg/kg resulted in 1.94 percent body weight gain, compared to 6.14 and 8.94 percent for the control and diabetic groups, respectively. At 250 mg/kg, LSTA significantly (p0.001) reduced blood glucose, cholesterol, triglyceride, and urea levels in diabetic rats. According to the above findings at a dose of 250 mg/kg, LSTA demonstrated potent hypoglycemic activity. The alkaloid from L. sativum demonstrates hypoglycemic activity against alloxan-induced diabetes by reducing oxidative damage and modulating antioxidant enzymes. The mechanism by which LSTA exerts its hypoglycemic activity is thought to be potentiation of pancreatic secretion of insulin from the remaining cells [18]
3.	Anti-inflammatory effect of Lepidium sativum:	Anti-inflammatory effects were discovered in extracts from the leaves and seeds. Flavonoids, alkaloids, cyanogenic glycosides (traces), tannins, glucosinolates, sterols, and triterpenes all help to assist this action. Bruised seeds mixed with lime juice can be used locally to reduce inflammation and rheumatic pain [19].
4	Bone fracture healing effect of *Lepidium sativum*	*Lepidium sativum* has long been used to aid in the healing of bone fractures. The effect of this herb on bone fracture healing in rabbits was studied by the authors (Newziland white rabbits). They were divided into two groups: intact rabbits in the control group and rabbits in the test group who had an induced fracture of the left femur's mid shaft. Over the period of six to twelve weeks, the test group's diet was supplemented with *Lepidium sativum* seeds, and x-rays were used to track the progress of fracture healing. Observations and data demonstrated that *Lepidium sativum* plays a key role in bone fracture healing, confirming its traditional use for this purpose. Several additional studies came up with similar findings, highlighting the need for more research topic [20]
5	Hepato-protective effect of *Lepidium sativum*:	Hepatoprotective effects of *Lepidium sativum* seed extracts against CCl4-induced hepatotoxicity have been demonstrated. When 200-400 mg/kg of seed extract was added to the regular meal of Albnio wistar rats, hepatotoxicity and CCl4-induced damage were significantly reduced. Compare and contrast the outcomes of three groups: control, CCl4-induced liver damage, and CCl4-induced liver damage treated with *Lepidium sativum* seed extract. They discovered that in CCl4-induced hepatotoxicity, blood levels of ASP (aspartate amino transferase), ALT (alanine amino transferase), and bilirubin concentration were significantly higher after 10 days. However, in the group treated with *Lepidium sativum* seed extracts, these parameters were significantly reduced. The presence of flavonoids, tannin, alkaloid, cuomarine, and triterpenes, which produce an antioxidant, is linked to this hepatoprotective effect and a decrease in CCl4-induced free radical production, which is the main cause of hepatotoxicity [21].
4	Antihypertensive effect of Lepidium sativum	The antihypertensive effects of aqueous extract of *Lepidium sativum* on rats with normotensive (WKY) and spontaneously hypertensive (SHR) hypertension were studied. A three-week treatment of 20 mg/kg aqueous extract in SHR rats resulted in a substantial decrease in blood pressure from day seven through the completion of the therapy, but no significant change in blood pressure in WKY rats [22].
5	Diuretic effect	The diuretic impact was investigated by administering 100 mg/kg of aqueous extract, which resulted in a substantial rise in urine elimination of Na, K, and Cl, which increased H2O exertion in SHR. Furthermore, no significant change in heart rate was seen in either SHR or WKY.
6	Antimicrobial activity of *Lepidium sativum*	The antibacterial activity of *Lepidium sativum* was investigated using the Agar well diffusion technique. The plant extract is created using a petroleum ether solvent. On an agar plate, bacterial suspensions of (Staphylococcus aureus, E. *coli*, Klebsiella pneumonae, Proteus vulgaris, Pseudomonas aeruginosa, and Candida

		albicans) are prepared and grown. The extract is then shown. After incubation under optimal circumstances, clear zones in the agar plate indicate growth inhibition. Benzyl isothiocyanate, flavonoids, tannins, triterpenes, alkaloids, sterols, and glucosinolates have antimicrobial action. Tannins inhibit protein synthesivums by forming an irreversible bond with proline-rich protein [23].
7	Anti-diabetic effect of *Lepidium sativum*	The current study attempted to assess the stimulation of the pancreas of rats with streptozotocin-induced diabetes using methanol extracts of garden cress seed (*Lepidium sativum*) and cinnamon (20% w/w). The positive control diabetes group had a significant increase in fasting blood sugar, lipid peroxide, interleukin-6, carboxymethyl lysine, serum uric acid, urea, creatinine, immunoglobulins, and serum uric acid, urea, creatinine, and immunoglobulins and urinary albumin, as well as a considerable reduction in antioxidant enzymes, sodium ions, potassium ions, and urinary creatinine. Severe Histopathological alterations in the kidney and pancreatic tissues were likewise observed in the positive control diabetic rats' group. Meanwhile, the groups who received 20% garden cress seed and cinnamon methanol extracts showed a considerable improvement decrease [24].
8	Chemoprotective effects of Lepidium sativum:	Pre-treatment of roots with *Lepidium sativum* juice (0.8ml) and its metabolised compounds such as glucotropaeolin (GT) and benzylisothiocynate (70mg/kg) for three consecutive days resulted in a 75-92 percent reduction in quinoline-induced DNA damage in colon and liver cells [25].
9	*Lepidium sativum* use in treating bronchial asthma:	An experiment was conducted to investigate the efficacy and safety of *Lepidium sativum* (L. *sativum*) (Garden Cress, Fam: Cruciferae) in bronchial asthma patients. L. sativum seed powder was administered orally at a dose of 1 gm thrice a day to 30 patients of either sex aged 15-80 years with mild to moderate bronchial asthma who were not using any other medications. A spirometer was used to measure respiratory functions (FVC, FEV1, FEF25-75 percent, and MVV) before and after 4 weeks of treatment. The drug's efficacy in alleviating clinical symptoms and intensity of asthmatic episodes was assessed by interviewing the patient and doing a physical and haematological examination at the conclusion of treatment. After 4 weeks of treatment with the medication, there was a statistically significant improvement in different pulmonary function measures in asthmatic individuals There was also a considerable improvement in clinical symptoms and the severity of asthmatic attacks. L. sativum had no negative effects on any of the patients. The current study's findings imply that L. *sativum* seeds may be beneficial in people with bronchial asthma [26].
10	*Lepidium sativum* in osteoarthritis intervention	Because *Lepidium sativum* has anti-inflammatory properties in Ayurveda and contemporary research, a study of *Lepidium sativum* seeds in the management of osteoarthritis was done. Patients were divided into two groups. Patients in the treatment group were given two doses of *Lepidium sativum* powder orally twice a day. The starch was administered to the control group (2 capsules thrice daily). The treatment lasted 30 days. The intensity, duration, and frequency of osteoarthritis symptoms before and after therapy were compared to assess the effects. The treatment group's majority of patients received symptom reduction (30% full remission, 37.5 percent considerable improvement, 25 percent moderate improvement, and just 7.5 percent would not improve). Finally, the plant seeds significantly reduced joint discomfort, stiffness, oedema, soreness, and movement issues afflicted by osteoarthritis *Lepidium sativum* has all of the attributes of a modern osteoarthritis treatment regimen (it has analgesic and anti-inflammatory capabilities, as well as an acceptable amount of Ca+2 ions), all of which serve to prevent the degradation caused by this illness [27].
11	Laxative effect of *Lepidium sativum*	Garden cress seed contains mucilaginous materials composed of cellulose (18.3 percent) and uronic acid polysaccharides. The presence of water in the GI system causes swelling. This swelling is caused by polyuronide. chains containing ionisable carboxyl groupings that become when there is water present moistened and swelled, as well as the cellulose Micelles break apart and disperse. The dimensions of the micelles of cellulose, chain length, and the all of the hydrated polyuronides ascertain the degree of mucilaginous Dispersion of matter This characteristic demonstrates that. Garden cress seeds can be used for a variety of purposes. Constipation was used as a laxative tested on mice with aqueous methanolic Cress seed extract at 30 and 100 mg/kg. In addition, another test on isolated gut the preparations of guinea pig and mouse Using a dosage of 0.1 mg/ml resulted in stimulatory actions in both the jejunum and the colon ileum that is affected by concentration [28].

Application as an excipient in pharmaceutical dosage form

Use as a Film forming agent: The effect of glycerol concentration (25, 35, and 50 percent w/w) on the production of edible film from cress seed gum was investigated. The water vapour permeability of the edible films was found to increase as the glycerol concentration in the film formulation increased, resulting in improved flexibility and significantly lower film tensile strength and higher elongation at break. The b and L indexes increased as the glycerol concentration in the film medium increased, while the E index decreased [29].

Use as A encapsulating agent

Cress seeds absorb water quickly, forming a viscous mucilage. These seeds have a mucilaginous content ranging from 6.5 to 15%. This mucilage is made up of hydrocolloids, which have a variety of uses in the food industry. Cress seed mucilage contains two sugars: mannose (38.9%) and arabinose (19.4 percent). The use of cress seed mucilage as the encapsulating wall material significantly improved the thermal stability of vitamin A [10] and. Furthermore, the mucilage was used to encapsulate curcumin via electrostatic interactions between the mucilage and sodium caseinate as a structural material [30].

It is used in controlled release system

It has a gel-forming capacity of husk powder derived from L. sativum seed in the range of 10 to 70% of total dosage form weight. Cross linking enhancers were chosen from specific xanthum gum and karaya gum in amounts ranging from 3 to 10% by specific weight of dosage form to provide an appropriate release profile between 4 and 20 hours (35) Create a novel interpenetrating polymer network (IPN) with L. sativum and (PVA), glutaraldehyde as a cross-linking agent to form microspheres containing simvastatin as an API using an emulsion cross-linking method. Different batches of IPN microspheres will be prepared. The final conclusion demonstrated the formation of these interpenetrating polymer net-work microspheres and the observation of oral controlled release of simvastatin [31].

Application as natural superdisintegrants

It is widely used in the pharmaceutical industry as a disintegrating agent and as a herbal medicine. Mucilage is more abundant in seeds, as are the dimeric imidazole alkaloids lepidine B, C, D, E, and F, as well as two new monomeric imidazole alkaloids semilepidinoside A and B. Mucilage can be extracted from seeds using a variety of methods [32].

Use as a gelling agent

Cress seed mucilage can form a gel-like consistency. This study determines the mechanical properties (gel strength, adhesiveness) and rheological properties of cress seed mucilage containing different minimum Carbopol concentrations. It also has synergistic effects. The combination of Carbopol and cress seed mucilage resulted in longer and more effective venlafaxine delivery via buccal route of administration [13].

Conclusion

Lepidium sativum Linn, on the other hand, was already known to Indian physicians prior to the sixteenth century. Seeds of garden cress (*Lepidium sativum*) are high in protein, dietary fibre, minerals, and essential amino acids. Garden cress seed was high in iron. Iron-rich supplements were discovered to be effective in improving iron status in the body. It contains phenolic compounds, which may account for its high antioxidant capacity. Garden cress (*Lepidium sativum*) seeds were found to be non-toxic and safe in toxicology studies. Seeds have a variety of medicinal properties, including antidiabetic, hypocholesterolemic, antihypertensive, antidiarrheal, antispasmodic, anti-inflammatory, antipyretic, and analgesic properties, as well as laxative properties. It is also used in the treatment of breast cancer and has hepatoprotective, fracture healing, diuretic, nephrocurative, nephroprotective, galactagogic properties. And *Lepidium sativum* mucilage is the one best example use for various kind formulation as a polymer because of biodegradable, biostable, and cost effective.

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