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Review Article

**LEPIDIUM SATIVUM CHARACTERISTICS AND AS A  
MULTIFACETED POLYMER: AN OVERVIEW****Manisha Supdu Sonawane, Amol Pandit Patil, Raju Onkar Sonawane,\* Pradyumna P. Ige,  
Priyanka Ganeshrao Patil**Department of Pharmaceutics, R.C. Patil Institute of Pharmaceutical Education and Research,  
Shirpur**Article Received:** March 2019**Accepted:** April 2019**Published:** May 2019**Abstract:**

*Lepidium sativum plant mucilage has been found to be multifaceted polymer that useful in development of efficient pharmaceutical dosage form. Lepidium sativum Linn (family Brassicaceae) it is edible herb contains mucilage and easily available and overall plant parts (roots, leaves and seeds) used to treat various disease condition. It also contains alkaloid moiety, carbohydrates, proteins, saponins, flavonoids, anthracene glycoside and also contain macronutrient, micronutrient. Crude extract of cress seed mucilage shows various biological activity like chemoprotective, antimicrobial, hypertension, bronchodilator, hypoglycaemic. isolation of seed coat mucilage by using various method to formulate efficient excipient and used in various pharmaceutical formulations. in various reported work on garden cress, and we are focused on chemical constituent, Isolation method, characterization, pharmacological profile and multifaceted application of Lepidium sativum.*

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**INTRODUCTION:**

Cress seed mucilage consist of polysaccharide and polyuronide complex of sugar and uronic acid units. and it's used in food and pharmaceutical industries because of it shows biodegradability, biocompatibility, nontoxic, low cost, eco-friendly and easily available in local market but it may be possibility of microbial contamination and that may be change in viscosity during storage condition and it shows PH dependent viscosity (1).

They are used in various properties as Gelling agent, water retention agent, thickening agent, emulsifying agent, binding agent, suspending agent, it also shows the sustained activity. (2) *Lepidium sativum* (Family-Brassicaceae) is a scientific name and common names of Garden cress seed Halim (Bengali), Chansur (Hindi), Haliv (Marathi). Cress seed and leaves are used in food preparation and other use of crees for house hold remedy to treat the health problems. (3)

Garden cress seed mucilage dark brownish in colour and oval in shape. some few studies elaborate chemical composition of seed 80-85% endosperm, 12-17% seed coat and other contain 2-3% embryo, 25% protein, 14-24% lipid, 33-54% carbohydrate,8% crude fibre.

It's a traditional medicinal system and used in various disease condition like hypertension, diabetic mellitus, cancer, CVS disease, kidney disease, mild glycaemia, seed contain essential fatty acids that help to improve memory boosters. (4)

**History**

Cress seeds Originated from Persia and after spread to various garden of India, Syria, Greece, Egypt. Cress is very popular and frequently consumed type of leafy vegetables in European country in Scandinavia, Netherland, England, France and its grown commercially in overall world for healthy including in salad and sandwich. (5)

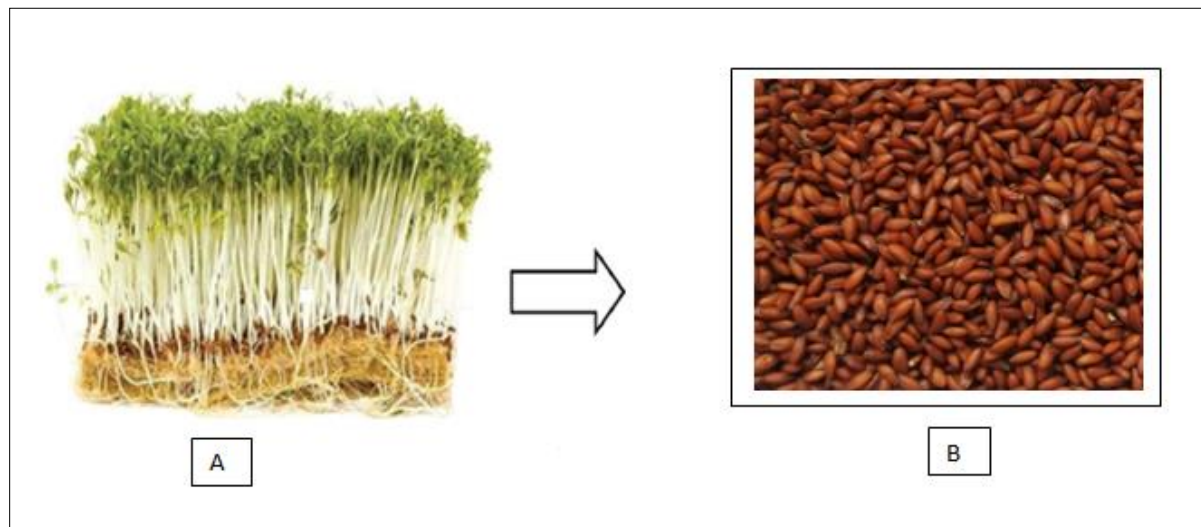


Figure No.1: A. cress seed plant B. Cress seed

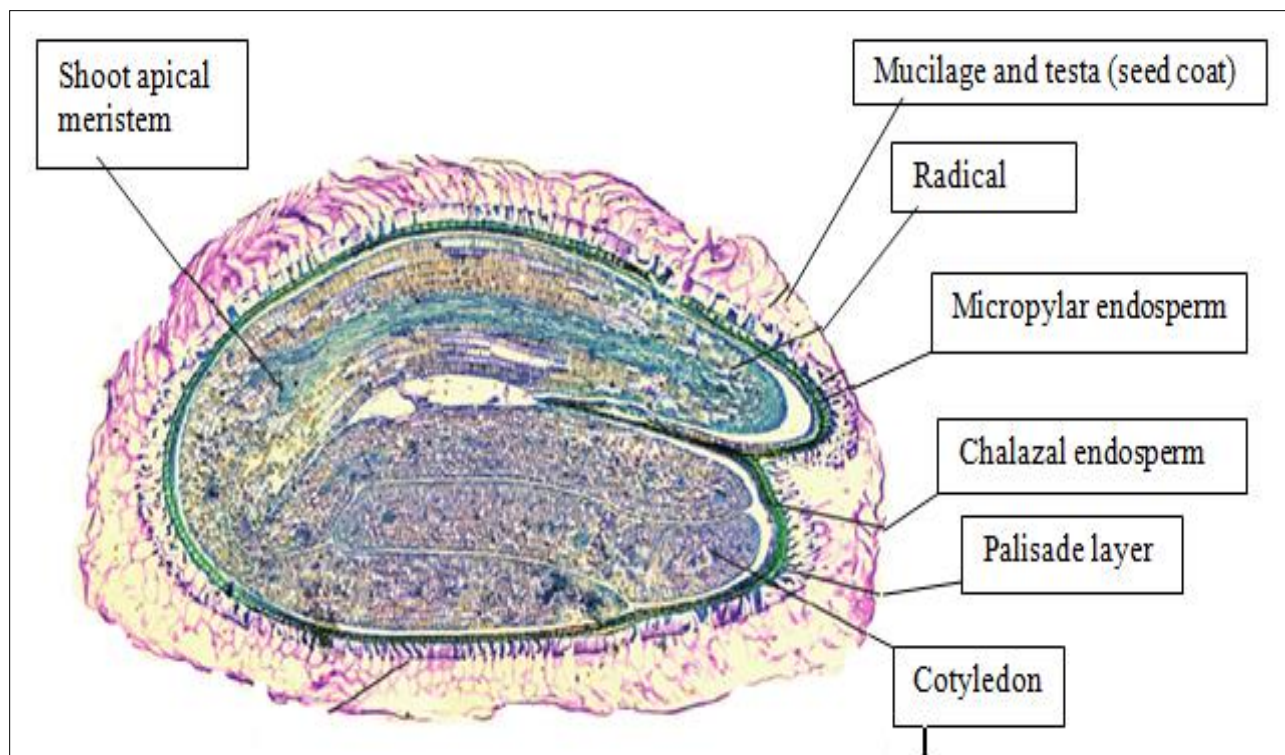


Figure No.2: T.S. of cress seed

Table 1: Morphological characteristics of *Lepidium sativum* seed (6)

Morphological characteristics	Observation
Shape	Oval shaped, pointed and triangular at one end
Size	3-4mm long, 1-2mm wide
Colour	Reddish brown
Seed length and width	Length- 298 $\mu$ m and width 100 $\mu$ m
Endosperm	Composed of thick-walled polygonal cells
The cell embryo	Small in size and polygonal shape

#### Chemical constituents:

*Lepidium sativum* chemical constituent present in different parts of plant like seed, leaf, Aerial parts

Cress seed contains: important alkaloid of lepidine, glucotropaeolin, N, N'-dibenzyl urea, sinapic acid and its choline ester (sinapin) and other contains carotene, cellulose, calcium, phosphorus, iron, thiamine, riboflavin, niacin, uric acid, L-arabinose, D-xylose, D-galactose, rhamnose, D-galacturonic acid and 4-O-methyl-D-glucuronic acid as the main components with D- glucose and mannose as traces components. (7) seed oil also contains palmitic, steric, oleic, linoleic, arachidic, lignoceric acid, benzyl cyanide, sterol and sitosterol. (8)

Cress leaf: contain carbohydrates, fat, mineral, phosphorus, calcium, some minute quantity of elements iron, nickel, iodine, cobalt, and also contains vitamin like thiamine, vitamin A, riboflavin, ascorbic acid, niacin. N-butanol fraction of aqueous-methanolic extract of leaves afforded three flavonol glycosides, quercetin-3-O-glucosyl(1 $\rightarrow$ 2)-glucopyranoside-7-O-glucopyranoside, kaempferol-3-O-glucosyl (1 $\rightarrow$ 2) - glucopyranoside -7 -O- glucopyranoside andisorhamnetin-3-O-sophoroside-7-O-D-glucopyran-soide .The presence of carotene has also been reported in the leaves of *L. sativum*.(9)

Aerial parts: of plant contains stigmast-5-en-3 $\beta$ , 27-diol-27-benzoate. It's also content of monosaccharide's analysis the presence of Ramones,

arabinose, galactose, glucose, and xylose. Minute quantity of fructose, mannose. (10)

#### Photochemistry

Lepidium sativum seed isolation and fractionation and detection of glucosinolate and fresh herb shown the presence of 2-ethyl butyl glucosinolate, methyl glucosinolate, and glucotropaeolin.(11) and it also content dimeric imidazole alkaloids such as lepidine B,C,D,E,F and two new monomeric imidazole

alkaloids semilepidenoside A,B were isolated structure elucidated on the basis of spectroscopic confirmation.(12) Different aerial parts of Lepidium sativum have been known as stigmast-5en- $\beta$ 27-diol-27-benzoate on the basis of spectral data analysed.(13) Seed mucilage isolated by precipitation with addition of 95% ethanol and evaluation of this mucilage by physicochemical characteristics. Chemical tests show the presence of carbohydrate, uronic acid and absence of tannins, chloride and sulphate (14)

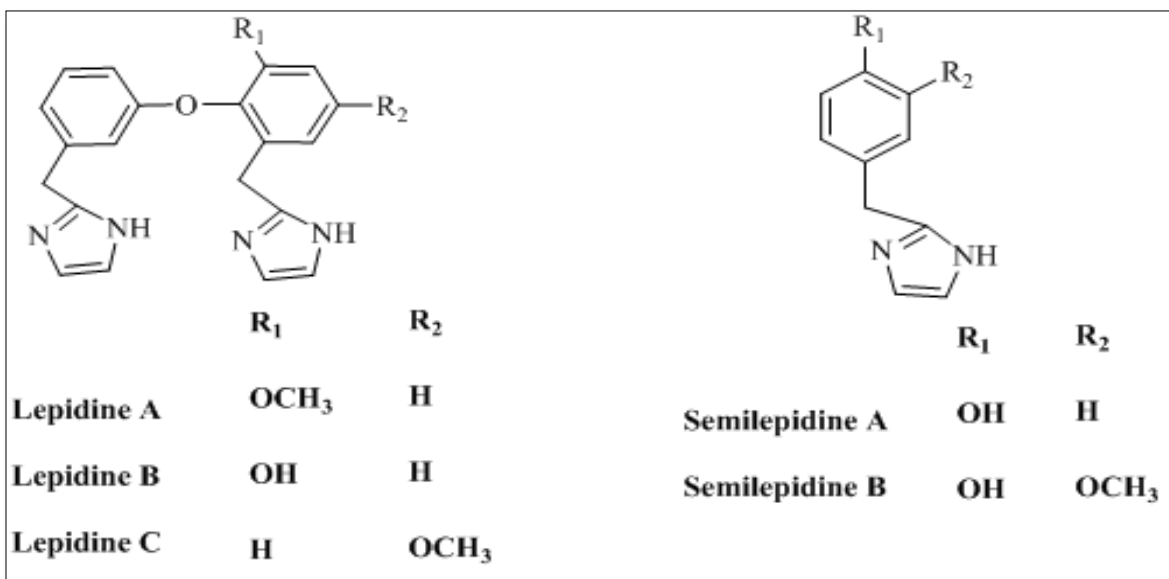


Figure No. 3: Phytochemistry of cress seed mucilage 1. Lepidine A,B,C, Semilepidine A,B

#### Extraction procedure of cress seed mucilage

Extraction of cress seed mucilage by using different extraction method and comparison of their obtained yield and properties.

#### Method 1: Precipitation of soaked and blended seed in acetone

Approximate 100g of seed were soaked into 800ml of distilled water for 12 hrs. after this soaked seed mixer blended for 15 min. on 2000 rpm by using with Phillips HR 1453 hand blender. this mixer filtered through muslin cloth. additional 200ml of water added again blended and filtered through muslin cloth to the maximum yield. this filtrate adds equal amount of acetone for precipitation of mucilage. White mass of supernatant separated by using muslin cloth or filtered it. precipitated mucilage spread on glass slab and dried in tray dryer at temp. 60°C for 16hr. mucilage easily separated in form of flakes by spraying acetone in glass slab. flakes were further dried at 60C for 5 min. mucilage transfer into the powder form by size reduction and this powder was sieved using 80# sieve. (15,17)

#### METHOD 2

##### Precipitation of soaked seed in alcohol:

Weighed quantity of 100gm of cress seed soaked in 1000ml of distilled water and by adding in 5ml of chloroform for 24hr. and this mixer filtered out by using muslin cloth. to the viscous solution added 1L ethanol 95% for precipitate the mucilage. after precipitated mucilage was collected and dehydrated at temp. 40 to 45°C. (16)

#### METHOD 3

##### Precipitation of powdered seeds soaked and blended in acetone:

Approximate 100gm of cress seed powder soaked in 1000ml water and added with 5ml of chloroform for 48 h and then extract was pass through sieve for filtration. The filtrate was collected and transferred into 1L of acetone for the precipitation. after that precipitated mucilage was collected and kept in freezer for 8hr and then dried in a freeze dryer. (16)

**Physicochemical characterization of cress seed mucilage (18)**

The extracted cress seed mucilage was evaluated for solubility, swelling index, ash values, extractive

values, moisture content, particle size, melting point, pH, microbial load, density, compressibility index, and angle of repose.

**Table No.2: Physicochemical characterization of cress seed mucilage**

Physicochemical characterization	Results obtained
Solubility profile of mucilage	slightly soluble in water, practically insoluble in ethanol, Methanol, acetone, ether, chloroform 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 (CFUs/g)	97(CFUs/g) 6(CFUs/g)
Density of powder: Bulk density (g/cc) Tapped density (g/cc)	0.2857(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) Test for tannins (Ferric chloride test) Test for sulphate (Barium chloride test) Test for chloride (Silver nitrate test)	Transparent angular masses Particles stained red Particles stained blue + - - -
Particle size: length breadth	1.3674 mm 0.875mm
IR spectroscopy	Major peaks at 2924 cm <sup>-1</sup> 1041cm <sup>-1</sup> for hydroxyl group, 2858, 1234,1666 cm <sup>-1</sup> for carboxyl group, 1604cm <sup>-1</sup> for keto group

and other physicochemical properties like average molecular weight of cress seed mucilage of 540 kDa and radius of gyration 75nm.(7), Zeta potential of cress seed mucilage  $-10.78 \pm 0.19$  mv and it shows anionic nature(19)

**Application of cress seed:**

*L. sativum* is various application for nutritional, medicinal properties for example a diuretic, and replacement of tonic, Galactogogue, aphrodisiac, carminative, rubefacient, its used as bronchitis, asthma and cure respiratory disorders. It is used as dietary supplement for lactating women to increase milk secretion during post-natal period and suggest for diarrhoea, dysentery. *L. sativum* aq. extract shows hypoglycaemic activity in equally normal and diabetic rats with not affecting insulin secretion. seed mucilage is used as a replacement for gum Arabic and tragacanth. It is also used as a human skin disorder. (14)



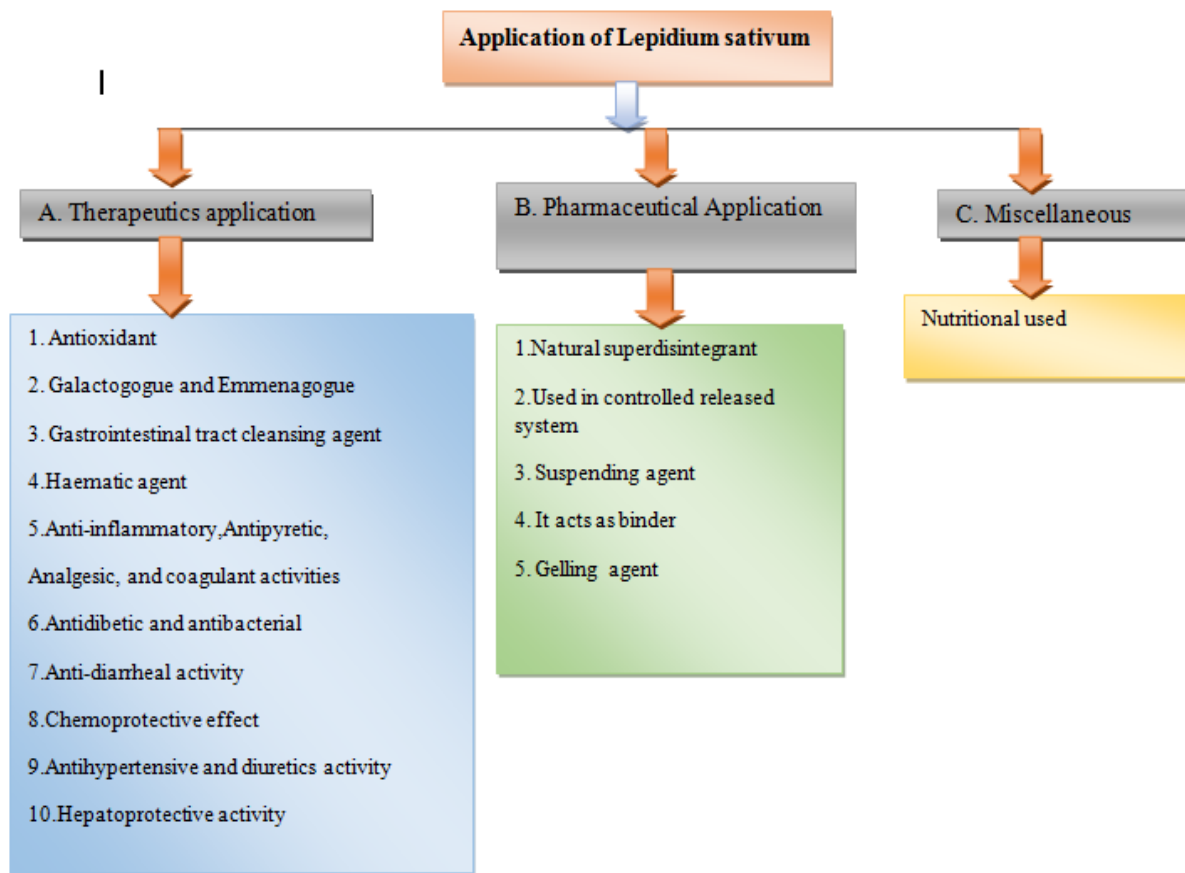


Figure No.4 Application of *Lepidium sativum* (cress seed)

#### A. Therapeutic applications:

**1. As antioxidants: free radical scavenging activity**  
Garden cress seed shows antioxidant properties on the basis of phenolic compound present such as tocopherols. seed have ability to collect free radicals and to prevent oil oxidation. tocopherol most important nutritional function for human being and rich source of vitamin E (20,21) It contains increasing amount of tocopherol present in GCS and it helps to stabilization of oils and fats to inhibit the oxidative deterioration and applied in dietary , pharmaceutical and biomedical products (11 ) Vitamin E is a essential for inhibit oxidation which cover Vitamin A and essential fatty acids from inhibit oxidation and protects the body tissue. seed have ability to control the DPPH activity at different conc. of 100,150, 200µg of extract in methanol as per reported of DPPH radical scavenger assay. In this different value correlate with the standard free radical scavenger butylated hydroxyanisole at 10,50,100µg. cress seed shows the high free radical scavenging ability and that's way rich nutritional and medicinal important. (22)

#### 2. As Galactogogue and Emmenagogue:

Cress seed helps to produce milk secretion, menstruation and supplement for control the menstrual cycle, that's way it shows mild oestrogenic properties. It acts as a emmenagogue like potential which have potential to excite menstruation. they help to provoke blood flow in the pelvic area and uterus and thus get a menstruation. seed gum used as a emmenagogue in order to provoke menstrual flow when menstruation is missing any due to pregnancy to cause an abortion or stop pregnancy and other than pregnancy condition like oligomenorrhea. in the same way, utilization of GCS behind delivery of baby maximum milk production and oozing in lactating mothers. since of its elevated iron and protein content, it is frequently known post-partum as efficient galactogogue to encourage lactation in treatment mothers to meet up the dietary essential of their children. Galactogogues help lactation in humans and other animals. They use their pharmacological effects during exchanges with dopamine receptors, ensuing in improved prolactin levels and in that way augmenting milk production. (23)

**3. As gastrointestinal tract cleansing agent:**

GC helps in washing out GIT and stimulates appetites. The savour a of these seeds contains higher amount of mucilage which can be able to useful of constipation, laxative and a purgative. GCS and honey mixer can be administered inside to treat amoebic dysentery. (4) the dysentery and diarrheal condition causes irritation of the intestine in that case used the germinated cress seed. mixer of germinated cress seed administered with hot is effective to treat colic disease particularly in infants. another used in treat the bleeding piles. the plant used to treat the bleeding piles. (24)

**4. As haematic agent:**

Higher amount of iron present in GCS, which is effortlessly absorbed in intestine and helps to elevate the hemoglobin level in blood. The easily bioavailability of iron content in GCS helpful for anemia condition in daily administration. (25) after half an hour administered vitamin C to help for better absorption. Vitamin C facilitate iron absorption to forming chelate complex in combination of ferric iron at acid PH exchange them to ferrous state and in this form easily soluble at the alkaline PH of duodenum which gets simply absorbed (23)

**5. Anti-inflammatory, anti-pyretic, analgesic and coagulant activities:**

*L. sativum* present flavonoid group that helps to reduces inflammatory mediators. (27) ethanolic extract of *Lepidium sativum* seed has been studied for various activity like anti-inflammatory, anti-pyretic, analgesic, coagulant activities. (4)

**6. Anti-diabetic and anti-bacterial:**

cress seed used as a Anti-diabetic and anti-bacterial properties due to the presence of benzyl isothiocyanate (28) The blood glucose levels be normalized in 2 weeks after daily continual oral administration of the aq. *L. sativum* extract (20 mg/kg) ( $p < 0.001$ ). Blood glucose levels were significantly reduced in normal rats after both acute ( $p < 0.01$ ) and chronic treatment ( $p < 0.001$ ). No difference was observed in basal plasma insulin conc. after treatment also in normal or streptozotocin induced diabetic rats signifying that the primary mechanism of this pharmacological action seems to exist self-governing of insulin secretion (29). The anti-bacterial effect of ethanolic and aq. extracts of the medicinal plant was investigated on Gram negative and Gram-positive bacteria. It was also observed that the ethanolic extract act as enhanced anti-bacterial agents than the aq. extracts. (30)

**7. Anti-diarrheal activity:**

Anti-diarrheal effect of alcoholic and aq. extract of *L. sativum* seeds by using three animal models (Castor oil induced diarrhoea in rats, Prostaglandin induced enteropooling in rats and charcoal meal test in mice) of diarrhoea; that observation aq. extract seed more potent than alcoholic extract. (31)

**8. Chemoprotective effects:**

*L. sativum* juice in 0.8ml and important metabolized chemical constituents such as glucotropaeolin, and benzyl isothiocyanate (70mg/kg) for three repeated days caused a considerable decrease in quinoline induced damage the DNA in specific colon and liver cells in that ranges of 75-92%. (32)

**9. Anti-hypertensive and diuretic activity:**

The volume of urine was considerably greater than before in two doses of aq. methanol extracts compared to control group  $K^+$  and  $Na$  excretion was increased when treated with aq. extract at 100 mg/kg, p.o.  $K^+$  conserving effect was observed in methanolic extract (33) The anti-hypertensive as well as diuretic effects were showed in both normotensive and impulsively hypertensive rats. Another study of researcher revealed that, oral administration of aqueous extract of *L. sativum* at 20 mg/kg produced a significant increase of urinary excretion of sodium, potassium and chlorides in normotensive as well as spontaneously hypertensive rats (34)

**10. Hepatoprotective activity and pesticidal activity:**

*L. sativum* plant acute toxicity studies they prepared two different extract of petroleum ether and alcoholic extract but alcoholic extract safer than the petroleum ether extract both shows the hepatoprotective activity in the liver at the conc. 50g/ml. both extract of *L. sativum* showed strong activity against the white fly (*Bemisia tabaci*). It content glucosinolate and specific glucotropaeolin is act as a significant activity against the pest, which gave a highest mortality percentage on the adult stage (11)

**B. Application as an excipient in pharmaceutical dosage form:**

Cress seed mucilage useful as a pharmaceutical excipient for various potential such as a disintegrating, gelling agent, binding in appropriate proportion in pharmaceutical dosage forms

**1. Application as natural superdisintegrants:**

It acts as a superdisintegrants are added to the solid

dosage form to breakdown into small particle that helps to quickly dissolve. different comparative studies be performed to conclude the effect of natural superdisintegrants against the synthetic superdisintegrants. cress seed mucilage has been used to expand the fast dissolving tablet of nimesulide. as of the study, it was over that higher dissolution of tablet can be obtained as a mucilage concentration is 10%.(4) another formulation of orally disintegrating tablet of metformin HCl by using direct compression method using cress seed mucilage. The study shown that cress seed mucilage is a good pharmaceutical excipient and is efficient as a disintegrate at small conc. as 2.5% (28)

### 2. It is used in controlled release system:

*L. sativum* seed powder have ability to forming gel and used to prepared solid controlled release orally used unit dose pharmaceutical composition enclose one or more drug. It has gel forming capacity of husk powder in origin from *L. sativum* seed in the range of 10 to 70% of total weight of dosage form. cross linking enhancer selected from particular xanthum gum and karaya gum similar to in amount of 3 to 10% by specific weight of dosage form to give appropriate release profile between 4 and 20h (35) formulate the novel interpenetrating polymer network (IPN) by using *L. sativum* and (PVA), glutaraldehyde act as a cross linking agent to formation of microspheres containing simvastatin as a API by using emulsion cross- linking method. different batches formulate of IPN microspheres be prepared. The ultimate conclusion showing to these interpenetrating polymer net-work microspheres form and it observed oral controlled release of simvastatin. (36)

### 3. Application as suspending agent:

In comparison *L. sativum* seed mucilage as a suspending agent in suspension and another formulation tragacanth based marketed paracetamol suspension that's way the *L. sativum* seed mucilage used as a natural suspending agent (37)

### 4. It act as binder:

*Lepidium sativum* seed mucilage used as binding agent in tablet formulation at 2% concentration used in wet granulation and 4% concentration used in direct compression for uncoated tablets. binding properties increased while decreased in friability with increased in conc. of *Lepidium sativum* seed mucilage. LSM binding solution necessary as compared to less than other binder due to its viscosity and sticky nature. (28,38)

### 5. Gelling agent:

Cress seed mucilage it has ability to form gel like consistency this study identify the various mechanical properties like (gel strength, adhesiveness) and rheological properties of cress seed mucilage containing different minimum conc. of carbopol. And its shows synergistic effects. The combination of the carbopol and cress seed mucilage resulted in prolonged and higher venlafaxine delivery by buccal route of administration. (19)

### C. Miscellaneous application

#### Nutritional used:

Cress seed contained 86.90% researcher concluded that higher amount of water absorption capacity (229ml H<sub>2</sub>O/100g). Isolated garden cress seed it has potential ingredient used in meat, bread, and cakes industries. Hence the protein isolated from garden cress seed can be desirable food ingredient and can be used as supplementation or nutrient substitution and as useful in food system. (39)

Cress seed contains high amount of iron, protein and specific amount of calcium is present and it also helpful to treat the certain disease. formulated the different form of cress seed powder like whole garden cress seed powder, Husk removed garden cress seed powder, Husk of garden cress seed as powder, Roasted garden cress seed powder, Microwave process garden cress seed powder and they prepared wheat based food product like Mathri was prepared by using different forms powder at different levels (2.5%,5% and 7.5%). Authors revealed that 5% husk removed GCSP showed higher nutritional than standard mathri and has ability to nourishing as well as therapeutics agent and antioxidant potential of garden cress seed (40)

#### Side effects of garden cress seed

It is an abortifacient (substance that induces abortion), if had in excess Pregnant women should avoid taking garden cress in any form since it has the capacity to induce uterine contractions and there by trigger spontaneous abortion. It contains goitrogens that inhibit iodine absorption in thyroids and for this reason can lead to hypothyroidism. therefore, it cannot be suitable for patients suffering from hypothyroidism. If bulk quantities of garden cress are consumed, can cause digestive difficulties in some people. The oil obtained from GCS is safe to eat and is used as a cooking medium; though, a number of people may experience symptoms of upset stomach due to its use. To conquer these problems, people must discontinue using this oil or mix it with some other edible oil, so as to dil. it and decrease its adverse effects. (41)



**CONCLUSION:**

*Lepidium sativum* (Garden cress) belongs to family Brassicaceae and is a popular herbal plant grown in various region India, Syria, Greece, Egypt and frequently consumed type of vegetables in various country like Scandinavia, Netherland, England, France. the plant also contain polysaccharide and polyuronide complex, imidazole, lepidine, semilepidinoside A and B,  $\beta$ -carotenes, ascorbic acid and other chemical constituent that way useful in various disease condition like Antioxidant, laxative, chemoprotective, antidibetic, analgesic coagulant, antihypertensive and diuretics. It has widely used in pharmacy field as a suspending agent, film forming agent, binding agent, gelling agent, controlled released formulation.

*Lepidium sativum* has potential to prepared the mucilage and consider the consistently in future prospective in research work development of the recently developed polymer as well as used in various formulation.

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