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Review Article

Scientific Update on the Pharmacognostic and Pharmacological Properties of *Brassica juncea*

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ABSTRACT

Since ancient times, many communities have employed plants to treat a wide range of illnesses, including infections. In underdeveloped and developed countries like, the aforementioned traditional plants serve a essential healthcare requirements. Plants' medicinal value is based on a number of secondary metabolites that are abundant in them and have pharmacological effects on the human body. Diverse products made from *Brassica juncea* have been used for a variety of medical purposes. Plant's seeds and the oils that can be extracted from them have been the focus of the majority of these historically recognized uses. The green edible leaves of this plant have also been described in more recent decades, and as a result, they are now frequently thought to be effective substitutes for other allegidly "healthy" Brassica vegetables. These green edible leaves contain a variety of bioactive molecules, as well as therapeutically intriguing pharmacological properties. The goal of this review is to summarize the molecular and scientific knowledge that is now available regarding *Brassica juncea*, including its phytochemical properties, pharmacological potential, and pharmacognostic traits. Data were acquired using Google, PubMed, Scholar, and other online venues

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INTRODUCTION

The term "medicinal plants" refers to a variety of plant species utilized in herbalism, some of which have medicinal properties. As the "backbone" of traditional medicine, medicinal plants are said to be consumed everyday by some 3.3 billion people in less developed nations.[1] Medicinal plant are widely utilized as raw materials to extract the active components that are then used to synthesize various medications. Similar to laxatives, blood thinners, antibiotics, and anti-malarial drugs all contain plant-based components. In addition, the respective active components of Taxol, vincristine, and morphine were isolated from foxglove, periwinkle, yew, and opium poppy. According to the WHO, health is not just the absence of sickness or disability but also a condition of whole physical, mental, and social wellbeing. By the year 2000, the WHO wants to ensure that every person globally leads a sustainable socio-economic productive life. Medicinal plants can have a significant impact on achieving this aim.[2] As a foundation for maintaining optimum health, the majority of developing nations use traditional medicine and medicinal plants, which has been closely examined by UNESCO since 1996.[3] The evolution of human civilization, including religions and many rites, has been significantly influenced by medicinal plants. A large number of current medications, including aspirin, are made in part from medicinal plants. The impacts of many food crops, including garlic, are therapeutic. The latest medications come from medicinal plants. The number of flower plant species is thought to be around 250,000. Knowing plant toxicity and defending against natural toxins are two benefits of studying therapeutic plants.[4]

The percentage of vascular plants utilized for medicine is 10%. Traditional medicine is a term that refers to the progressive refinement of the use of these plants through many generations.[4] Traditional medicine is defined as "the body of knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement, or treatment of physical and mental

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illnesses," according to the official definition.[5] Since ancient times, many communities have employed plants to treat a wide range of illnesses, including infections including *Brassica juncea*. In this review, pharmacognostic and pharmacological of *Brassica juncea* have summarized.

BRASSICA

Brassica is a genus of plants in the family of mustard and cabbage (*Brassicaceae*). The genus' members are colloquially referred to as mustard plants, cabbages, or green vegetables. The name "Cole crops" for plants in this genus comes from the Latin word "caulis," which refers to a plant's stem or stalk.[6] Brown mustard is a type of mustard that is made from *Brassica juncea* seeds and has been used for food and medicine for many years. The traits and medicinal applications of these two kinds are each given in-depth description in the Ayurvedic Samhita. Despite being essentially two different herbs, they have a lot of the same qualities. The black variant is classified as kandughna, an antipruritic, and the white variety is classified as asthapanopaga, an adjuvant to decoction enemas.[8,9]

BRASSICA JUNCEA

Brassica juncea has a strong potency, a spicy and bitter flavour, and a strong taste. It reduces kapha and vatadoshas. It has qualities of brightness and precision. Its properties include being emetic, digestant, anti-inflammatory, and irritating. It treats conditions like abdominal pain, anorexia, worms, spleen illnesses, tumors, and wounds.[7] Indian mustard (*Brassica juncea*) has been found as a high biomass, quickly growing plant with the capacity to accumulate Nickel and Cadmium in its shoots and as a potentially useful plant for phytoremediation.[10]

Plant Description

Brassica junea is an annual with a height of 70–170 cm (Figure 1 and Table 1).

Steam: Solid, Herbaceous, and Erect.

Flower: The flower is full, regular, hermaphrodite, tetramerous, and hypogynous.

The calyx is made up of two whorls of two free and caducous sepals apiece. The outer two lateral sepals are frequently broad and saccate at the base, whereas the inner two are narrow. The aestivation is embedded.

Four separate, free petals that are placed in a whorl make up the corolla. The fundamental characteristic of the identity family is the cruciform groupings of petals. It is valuable to aestivate. Six stamens are found in the androecium, which has two whorls. Tetradynamous type arrangement refers to the outer two small stamens and interior four long stamens.

Syncarpous, bicarpellary gynoecium. Ovary is superior and unilocular, but develops a fake septum, known as a replum, that makes it bilocular. In the ovary, a parietal placentation is visible.

Leaves: Ex-stipulate with hairs, Simple, Alternate.[18]

Plant Botany

Common Name- Various common names are employed, such as brown mustard, Chinese mustard, or oriental mustard.

English- Black mustard seed or Brown mustard seed

Hindi- Rai, laalsarsu

Gujrati- Rai

Marathi- Mohari

Tamil- Kadugu

Punjabi- Rai

Telugu- Avalu

Assamese- Jatilai

Bengali- Sarsapa

Kashmiri- Sarshaph

Sanskrit- Rajika, Sarshapa.

Agriculture

Despite being widely distributed throughout Asia, Africa, Europe, and North America, some writers contend that China, Eastern India, and the Caucasus are where the majority of *Brassica juncea's* genetic diversity is found.[11]

TRADITIONAL USES

Only rapeseeds and mustards of the canola quality are grown in Australia and New Zealand to make edible oil for human consumption. Due to the low quantities of erucic acid that canola oil contains as a result of controlled breeding initiatives, Food Standards Australia and New Zealand (FSANZ) has authorized its use as safe for Australian and New Zealand consumers. The heart can become toxic when erucic acid is present in large amounts.[12] Other oils having a higherucic acid content, such as some rapeseed and mustard seed oils, are not frequently used as cooking or baking oils. Additionally, canola oil is used to make margarine and spreadable food blends, and the leftover grain is fed to animals.[13] Broad-spectrum pesticides are used to combat fungus, insects, and nematodes using *B. juncea* seed meal.[14]

A use for Swollen Stem Mustard in Medicine - The herb is used as a folk treatment for rheumatism, lumbago, foot pain, and arthritis (Figure 2). In China, the seed is applied to the treatment of tumours. The seeds are used in Korea to cure stomach problems, lumbago, rheumatism, colds, and abscesses. In Africa, the root is employed as a galactagoge. Mosquitoes may become

Figure 1: *Brassica juncea.*

insect-repellent after ingestion. Ulcers and skin outbreaks are treated with mustard oil. The volatile oil is utilised as a stimulant and counterirritant since it is thought to be aperient and tonic. The herb is utilised as an emmenagogue in Java to treat syphilis.[15,16]

CHEMICAL COMPOSITION

Additionally, mustard oil, an essential oil from *B. juncea*, has been utilised in cosmetics to manage hair.[17] It is also one of the essential ingredients used to make yolk sauces, spicy sauces, and curry powders.[18] Jiemo is its name in Chinese. In actuality, the bitter flavor of *B. juncea's* dried seeds is absent. Only until the seeds are pulverized and macerated in water under precise circumstances does the pungent flavour emerge.[19]

This is because the seeds of *B. juncea* contain Thioglucosides (TGDs), the building blocks for the plant's essential oil.[20] To create isothio-cyanates or other chemicals containing sulphur, TGDs are hydrolyzed. The essential oil's content and yield are impacted by the hydrolytic conditions of TGDs. Allylisothiocyanate is the primary ingredient in mustard oil.[21,22]

PHARMACOLOGICAL ACTIVITIES (Table 2)

Antioxidant Activity

Vitamins A and C, phenolic compounds, glucosinolates, and other substances with antioxidant qualities are abundant in mustard.[23] The 50% acetonitrile extract of the Korean Dolsan Leaf mustard (*Brassica juncea*) was tested for its antioxidant capacity. Leaf mustard seeds had a somewhat higher level of antioxidant activity than other sites. The antioxidant activity of leaf mustard and its polyphenols was demonstrated in the ABTS (2,2'-Azinobis-(3-ethylbenzthiazoline-6-sulphonate), EDA (Edavarone), and FRAP (Ferric ion reducing antioxidant power) assays. It was linearly correlated with flavonoid level, and the antioxidant effect may be mediated by flavonoid and polyphenol content.[24]

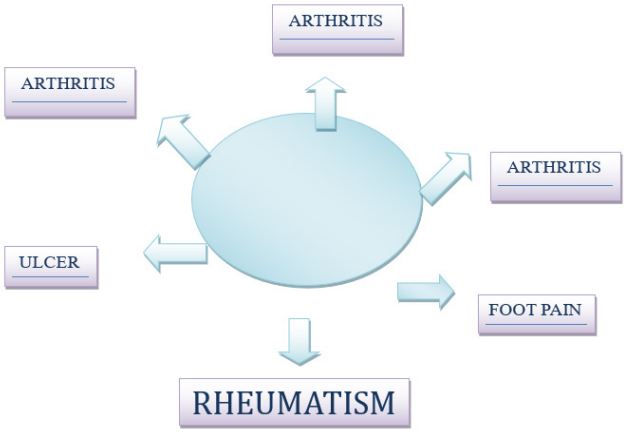

Figure 2: Traditional uses of *Brassica juncea.*

Anti-obesity

Despite the paucity of research in this area, one study on high-cholesterol diet-induced Sprague-Dawley obese rats found that 3% and 5% of *Brassica juncea* L. leaf 80% (v/v) ethanol extract had therapeutic effects. It was found that both extracts enhanced the serum and organ lipid parameters in rats, controlled the expression of genes and proteins involved in the creation of fat and cholesterol, and decreased cholesterol. The amount of mesenteric, epididymal, and total adipose tissue mass decreased significantly in the rats treated with the extract as compared to the control group (p .05.) In rats given *Brassica juncea* L. leaf extract, the mRNA expression levels of the lipogenic enzymes G6pdh, Acc, and Fas were dramatically decreased (p .05). *Brassica juncea* L. leaf 80% (v/v) ethanol extract may have a therapeutic impact on obesity, which appears to be related to the reduction of G6pdh, Acc, and Fas gene expression, according to the results, which revealed that the liver and cholesterol levels improved following extract therapy.[25]

Anticancer Activity

Mustard's bioactive components, including polyphenols, flavonoids, glucosinolates, and their breakdown products,

Table 1: Pharmacognostic standardization of *Brassica juncea*.

Sl. No.	Parameter	Seed	Leaves	Flower
1	Shape and size	Round (2.5-50cm) Length	Rosette shape 25–35 cm, length	Cross-shaped 4.5-8(-10) mm Long
2	Odour and Taste	Pungent	Pungent	Pungent
3	Color	Yellow or Brown red	Dark green	Bright yellow

Table 2: Pharmacological activities of *Brassica juncea*.

Activity	Extract	Dose	Model	Animal	References
Wound healing	Aqueous	200mg/kg	Cut and Seizure	Adult male Wistar albino rats	[57]
Anti-obesity	Ethanolic	200mg/kg	High-Cholesterol diet	Male Sprague-Dawley Rat	[58]
Anxiolytic-like Activity	Methanolic	200mg/kg	Non-diabetic and Alloxan-diabetic rats	Adult Charles foster rats and Albino mice	[59]
Anti-inflammatory	Methanolic	1000mg/kg	Carrageen induced paw edema	Rats	[60]
Anti-hyperglycemic activity	Methanolic extract	200mg/kg	Streptozotocin- induced rats	Ablino Wistar rat	[61]

Table 3: Product of *Brassica juncea*[56]

Product	Company Name
Fortune mustard oil	Adani Wilmar Limited., (AWL) (Fortune)
Patanjali mustard oil	Patanjali Ayurved Limited., (Patanjali)
Dhara mustard oil	Mother dairy (Dhara)
Dabur mustard oil	Dabur India Ltd., (Dabur)
Brown mustard seed	Jairamdass Khushiram - JK Botanicals Private Limited
Yellow mustard seed	Chhindwara Trading Company
Mustard ointment	W.T. Rawleigh Company

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especially glucosinolates like sinigrin and its breakdown product isothiocyanateallyl acid, sulforaphane, and indole-3-methanol, are thought to be closely related to the mustard's anti-proliferative and preventative effect on tumour cells.[26] Red mustard has higher anticancer activity than green mustard, particularly for SNU-251 and SNU-C4 cancer cells. The anti-cancer activity of glucosinolates from Korean green and red mustard against four different cancer cells, SNU-251, SNU-354, SNU-C4, and MCF-7. Sinigrin was shown to be the main active component of the red and green mustard extract. Additionally, it has been demonstrated that lung cancer cells are greatly inhibited by the breakdown products of glucosinolates, such as allylisothiocyanate, phenethylisothiocyanate, sulforaphane, and benzyl isothiocyanate.[27,28] Sulforaphane dramatically reduced the activity of esophageal adenocarcinoma, colon, and lung cancer cells.[28-30]

Antibacterial Activity

Gram-positive and Gram-negative bacteria, such as Listeria monocytogenes and Staphylococcus aureus, were selectively killed by the crude extract of Oriental mustard (*Brassica juncea* L.) seed meal and its purified polyphenol. *Escherichia coli, Bacillus subtilis, Listeria monocytogenes, Staphylococcus aureus,* and *Pseudomonas fluorescens* all required a minimum inhibitory concentration of hydrolyzed extract of 0.1 g/L or less.[31]

Antifungal Activity

Aspergillus flavus was successfully combatted by hexane extract of plant seeds.[31] *Aspergillus niger, Aspergillus flavus, Trichoderma viride, Candida albicans, Candida tropicalis, Cryptococcus neoformans, Trichosporon mucoides, Trichophyton tonsurans*, and *Geotrichum capitatum* were all significantly inhibited by the oil from plant leaves when tested using the microbroth dilution and disc diffusion method.[32] When tested against *Aspergillus flavus, Microsporum ferrogenium*, and Mucormucaralis, the ethanolic extract of plant seeds exhibited a high zone of inhibition. *Aspergillus flavus*, Mucormucaralis, and *Microsporum ferrogenium* were both highly inhibited by methanolic extracts of plant seeds, and *Aspergillus flavus*, Mucormucaralis, and *Microsporum ferrogenium* were all strongly inhibited by ethyl acetate extracts of plant seeds.[33,34]

Cytotoxicity

In vitro tests on human HDF cells using seeds from *Brassica juncea* revealed quite minor toxicity.[35] Lung (80%), ovary (68%), breast (55%) and CNS (47%) cancer cell lines were all cytotoxic to 24-EBL from Ni ion starved plant.[36]

At concentrations lower than 10 mg/mL, the methanolic extract of seeds exhibited minimal cytotoxicity to the MDCK cells.[37]

Anticonvulsant Activity

Against PTZ-induced seizures in mice, methanolic extract of the seeds demonstrated potent anticonvulsant efficacy.[38]

Anti-inflammatory activity

Brassica juncea leaves' acetone extract shown strong protease inhibitory action in *in vitro* anti-inflammatory tests.[39] *Brassica junce*a can reduce the myeloperoxidase activity in the ears of mice treated with tetradecanoylphorbol acetate (TPA), arachidonic acid (AA), or croton oil (CO), as well as the protein and m-RNA levels of TNF- and IL-6.[40] Gallic acid, which has potent anti-inflammatory properties, was found in higher concentrations in the methanolic extract of plant seeds.[41] Various other analysis also has been done on this mentioned plant by official methods.[42-49]

Anti-hyperglycemic activity

In mice with hyperglycemia brought on by glucose, a methanolic extract of plant leaves exhibited potent dose-dependent antihyperglycemicaction.[50] In streptozotocin-induced rats, the plant's methanolic extract significantly decreased blood glucose levels.[51] In alloxan rats, *Brassica juncea* seeds significantly reduced blood sugar levels.[52]

Antidepressant Activity

The goal of the study was to determine whether a methanolic extract of *B. juncea* leaves (BJ 100, 200, and 400 mg/kg/day, po) and imipramine (15 mg/kg/day, po) had antidepressant-like activity in diabetic and nondiabetic rodents induced by alloxan monohydrate (120 mg/kg, ip) using behavioral despair, learned helplessness, and tail suspension tests for antidepressants and locomotion.[53,54] The effects of therapies on norepinephrine, serotonin, and dopamine levels in the brain were also estimated. Animals with diabetes showed increased motility and depressed behaviours.[55]

Future prospects

Due to their reputation for safety and lack of side effects, herbal medicinal plants are a popular choice for treatment. They have a larger advantage over chemically processed items and synthetic treatments since they are in harmony with nature. Ayurvedic herbs, as opposed to other treatments and medications, are recognized for treating illness from the source and helping to maintain long-term health and fitness. The plant *B. juncea* has numerous primary and secondary metabolites that are used to treat a variety of acute and chronic illnesses; thus, there are numerous pharmacological actions that have not yet been identified. It may be straightforward for new researchers to comprehend those activities for the best plant study. The plant is used by Ayurveda, Siddha, and other medical systems to cure a number of illnesses. This plant's stem, root, bark, fruit, and leaves are just a few of the parts that are utilized to treat illnesses. This plant is very easy to Numerous phytochemicals have been discovered in various parts of *B. juncea*; they may one day be used to cure diseases and open up new avenues for research.

CONCLUSION

Plants are the living gifts of nature, which is a vast and significant source of many things. Although plants are useful in many different disciplines, their use as herbal remedies is a significant accomplishment. The world over, drugs made from plants are very well-liked and have relatively few adverse effects. Currently, the majority of the human population uses herbal treatments to treat illnesses, and they prefer herbal drugs simply because they have less negative effects. Despite being a beautiful decorative plant with a lot of pharmacological action, *B. juncea* has been found to be safe at various levels of research. Due to the plant's significant properties, which form the basis of several research areas, rigorous sociological research is necessary. In contrast to synthetic pharmaceuticals, which are viewed as dangerous and unhealthy for overall health, Ayurvedic medicines and products have developed a reputation for safety because to the use of natural ingredients and medicinal plants.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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