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Review Paper

Ethnomedicobotanical Study of Brassica Nigra (Black Mustard): A Comprehensive Review

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ABSTRACT

Brassica nigra (black mustard) is an important medicinal and edible plant traditionally used as spices belonging to the family Brassicaceae. It has been widely used in traditional medicine across Asia, Europe, China and Africa for the management of various ailments, including respiratory disorders, digestive problems, inflammation, rheumatic pain and skin diseases. This review aims to compile and critically summarize the available literature on the ethnomedicinal uses, botanical characteristics, phytoconstituents, pharmacological activities, nutritional value and therapeutic potential of Brassica nigra. Information was gathered from published research articles, books and authenticated scientific databases. The plant is rich in bioactive compounds such as glucosinolates, isothiocyanates, flavonoids, phenolic acids, alkaloids and essential fatty acids, which contribute to its antioxidant, antimicrobial, anti-inflammatory, anticancer, antidiabetic and cardio protective properties. The review also highlights traditional knowledge, cultivations aspects, safety considerations and future research opportunities for the development of evidence based herbal formulations. Overall, Brassica nigra represents a valuable medicinal plant with significant ethnomedicobotanical importance and promising pharmaceutical applications. Further clinical and toxicological investigations are recommended to validate its traditional uses and facilitate its integration into modern healthcare systems.

INTRODUCTION

There are many therapeutic compounds found in nature, and medications are derived from it. Human has historically used a range of medication for different types of illness and infections, for

example, osmium used for cough, cold, turmeric used for wounds to treat infection, such many more. With industrialization, chemical drugs are used to treat many diseases. As chemical drugs are having unintended and unavoidable side effects people are now growing there interest in herbal

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remedies as they are safe and free of side effects. Black mustard (*Brassica nigra*) has been used for thousands of years in Ayurveda for its diverse medicinal uses though it has been used as spice. This review is the collection of updated information of selected herbal plant regarding their biological source, synonym ^[1], collection, ethnomedicinal information, chemical constituents ^[2], traditional use, reported activities, their commercial, and geographical and suitability to the environmental conditions of their availability aspects. Since ancient times mustard plant has been grown and used as food ^[3], medicine and spices ^[4]. It is a traditional remedy for gastrointestinal, respiratory and skin illnesses because according to Ayurveda medicines it is appetite stimulant, laxative and expectorant, antiseptic as well when intended internally. In the United States Mustard is utilized as a spice. "Mustard" originated from Latin word *mustem* Arden. *Mustem* means "must" (new wine), and *Arden* means "burning", meaning the pungent. At that time it was used as anti-head-ache medicine. Combining it with vinegar and honey it was used to treat bronchial congestion. Also used by singers to get clear voice. Different parts of plant are used for the treatment of bronchial congestion, skin disease, anticancer, antimicrobial ^[5], antiepileptic, insecticidal ^[6], and antidiabetic. Locally it is taken in many forms, as paste, cream, oil, dried powder, mustard plaster^[7], fresh leaf. The present review circumscribes all available update information of *B.nigra* L. It motivates scientists to carry out more research on this plant's possible medical applications.

1. MATERIALS AND METHODS:

A comprehensive survey of literature relevant to ethnobotanical and ethnomedicinal study of *B. nigra* plant was carried out to build a literature review. Using Google search engines like PubMed, Google Scholar, and Science direct

literature search was conducted using the terms anti-cancer activity, antiviral activity of plants belonging to Brassicaceae family. Then the articles sorted for the selected plant. We selected the articles based on the relevancy and reliability of data related to ethnobotanical and ethnomedicinal survey including distribution areas, scientific plant names, synonyms, pharmacological activities, traditional uses, parts of plants used, different solvent extracts used for treatment in research. Information collected from research and review articles from Open access journal. Data analysis is done using different parameters as distribution, Phytochemistry, ethnomedicinal and traditional uses, pharmacological activities.

2. Taxonomy:

- A. Kingdom: Plantae
- B. Class: Magnoliopsida
- C. Order: Capparales
- D. Family: Brassicaceae
- E. Genus: *Brassica*
- F. Species: *B. nigra*
- G. Binomial name: *Brassica nigra* (L)

3. Monograph:

- A. Hindi name: Kali rai, Kali sarson.
- B. English name: Black or brown mustard seed, Indian mustard.
- C. Scientific name: *Brassica nigra*.L.
- D. Family: Brassicaceae.
- E. Duration: Annual.
- F. Growth habit: Forb.
- G. Nativity: Southern region of Europe, South Asia, in India Bihar, Uttar Pradesh.

4. Morphology:

- Annual, rigid, erect herb, 2-3 feet high, branched, forb.
- Upper leaves: smaller, sessile, elliptic or lanceolate, entire.



- Lower leaves: lyrate, deeply pinnatifid.
- Inflorescence: branched raceme, densely 40-50 flowered. Flowers calix 1.2 cm across;
- Pedicel: 3-5mm long, ebractate.
- Sepals: erect-spreading, oblong, obtuse, 4-5mm long, glabrous.
- Petals: obviates, long-clawed, 8-10mm long, bright yellow.
- Stamen: 4mm long.
- Fruits: oblong, 1-2 cm x 1-2,5mm; beak 2-3mm long, 3-5 seeded in each locule.
- Seeds: 1mm across, glabrous, dark brown. [8]

5. Distribution:

Black mustard (*Brassica nigra*) is obtained native in Southern Mediterranean region. Cultivated worldwide mostly in territorial and temperate regions as condiment, spice and oilseed crop. Most widely distributed throughout Europe, Asia [9], North Africa and Parts of North America. Grows well in fertile, well-drained loamy soils with adequate sunlight. The plant is cultivated for its seeds, leaves and medicinal value and it is also found growing naturally in fields, roadsides and wastelands.

6. Phytochemistry:

Brassica nigra contains a wide range of bioactive compounds, including glucosinolates [10] such as allyl isothiocyanates, flavonoids, phenolic acids, alkaloids [11], tannins, saponins, vitamins, minerals and essential fatty acids [12]. These phytochemicals contribute to the plant's antioxidant, antimicrobial, anti-inflammatory, chemo protective properties, making it an important source of natural therapeutic agents. The phytochemical investigations reported for *brassica nigra* demonstrate the presence of a diverse range of phenolic constituents across different plant and extraction systems. Leaves and areal parts have been reported to contain caffeic acid, benzoic acid,

gallic acid, chlorogenic acid and trans-cinnamic acid [13], whereas analysis of the whole plant using supercritical fluid extraction identified rosmarinic acid, ferulic acid, vanillic acid and caffeic acids [14]. Further investigations of leaf extracts obtained using methanol, water and supercritical fluid extraction demonstrated the occurrence of both hydroxycinnamic acids, including caffeic, *p*-coumaric, ferulic and sinapic acids, and hydroxybenzoic acid derivatives, including Gallic, protocatechuic, *p*-hydroxybenzoic and vanillic acids [15-16]. Thus, the available evidence indicates that phenolic acids constitute an important component of the phytochemical profile of *B. nigra*. The occurrence of caffeic, ferulic, Gallic, chlorogenic and sinapic acids is particularly relevant because these compounds represent structurally diverse phenolic groups with well-documented antioxidant and other biological properties.

In comparison with leaves and the whole plant, the seeds have also been characterized for their phenolic and flavonoid constituents. Methanol, water-acetone and ethanol extracts of *B. nigra* seeds have been reported to contain 3,4-dihydroxybenzoic acid, ferulic acid, sinapic acid and the flavonoid glycoside rutin. The occurrence of rutin together with phenolic acids suggests that the seeds contain multiple classes of secondary metabolites that may contribute collectively to their biological properties. More recent chromatographic investigations have further demonstrated the chemical complexity of *B. nigra* seeds, with compounds such as ferulic acid, rutin, catechin, chlorogenic acid, caffeic acid, vanillic acid and other phenolic/ flavonoid constituents being detected. This variation in the reported phytochemical composition may be associated with differences in plant part, geographical origin, cultivar, and maturity, extraction solvent and analytical conditions used in each investigation. [17-21]



The predominance of hydroxycinnamic acid and benzoic acid derivatives, together with flavonoids such as rutin, provides a plausible chemical basis for several of the antioxidant and other pharmacological effects reported for *B. nigra*. For example, HPTLC analysis of *B. nigra* leaf extract has identified gallic acid, quercetin, ferulic acid, caffeic acid and rutin, with gallic acid reported as the predominant quantified phenolic constituents in the study. [15] However, the available literature remains heterogeneous with respect to extraction procedures, analytical platforms and reporting of individual compounds. Therefore, direct

comparison of constituent abundance among studies should be undertaken cautiously. Future investigations should employ standardized extraction procedures and complementary analytical techniques such as HPLC-DAD, LC-MS/MS and NMR to provide more definitive qualitative and quantitative characterization of the phytochemical profile. Such chemical standardization would also facilitate the correlation of individual constituents with the documented ethnomedicinal uses and pharmacological activities of *B. nigra*.

Table no.1: Phytochemistry of *Brassica nigra*.

Plant part	Extraction solvent/ method	Major chemical class	Reported phytoconstituents	References
Leaves /areal parts (flower)	Honey-methanolic extract	Phenolic acids	Caffeic acid, benzoic acid, gallic acid, chlorogenic acid, trans-cinnamic acid.	[13]
Whole plant	Supercritical fluid extraction (SFE)	Phenolic acids	Rosmarinic acids, ferulic acid, vanillic acid, caffeic acids, rosemary acids	[14]
Leaves	Methanol, Water and SFE	Hydroxycinnamic and hydroxybenzoic acids	Hydroxycinnamic acids: caffeic acid, p-coumaric acid, ferulic acid and sinapic acid; Hydroxybenzoic acid derivatives: gallic acid, protocatechuic acid, p-hydroxybenzoic acid, vanillic acids.	[15][16]
Seeds	Methanol, water-acetone and ethanol extracts	Phenolic acids and flavonoids	3,4-Dihydroxybenzoic acid, ferulic acid, sinapic acid, and rutin.	[17][18] [19][20] [21]

7. Ethnomedicinal and Traditional uses:

Black mustard has been used in traditional systems of medicine for centuries. The seeds are commonly employed as a digestive stimulant, carminative and appetite enhancer. Mustard seed paste and oil are traditionally applied externally to relieve joint pain, muscle stiffness, rheumatism, and chest

congestion. In various cultures, the plant has also been used to treat cough, common cold, respiratory disorders, skin infections, and minor wounds. To cure internal ailments including thyroid gland tumors and lymph node swelling, poultices were used traditionally. Also it has been historically used internally to treat intestinal



worms, lower blood lipid levels, lessen the accumulation of fat or adipose tissue, and aid in the body's detoxification.^[22]

Table no.2: Ethnomedicinal and Traditional Uses of *Brassica nigra*.

Type of use	Diseases	Parts used and method	Reference
Digestive	Emetic, irritant and stimulant.	Seed	[23]
Respiratory	Bronchial-congestion, cold, cough, diaphoretic, expectorant,	Seed extract	[23]
Cardiovascular	Reduce congestion, Promotes Cardiovascular Health	Seed extract	[24][25]
Miscellaneous	neurotic pain and rheumatoid arthritis, treatment of the brain and lung edema, paralysis, migraine and epilepsy, toothaches, neck pain, snake and scorpion bites, wounds, Seizure, plaster preparation, diuretic, head ache	Seed extract Ground seed snuff, oil- alcohol lotion	[23][26][27] [28][29]
Hepatic diseases	Malaria fever	Seed extract	[30]

The ethnomedicinal and traditional uses of *Brassica nigra* demonstrate its wide application in traditional healthcare systems for the management of diverse health conditions. As summarized in Table no. 2, the reported uses encompass digestive, respiratory, cardiovascular, neurological, musculoskeletal, hepatic and other health-related conditions. The seeds are the principal plant part documented for these applications and are used in different forms, including seed extracts, ground seed preparations, snuff, oil-alcohol lotions and plaster preparations. This diversity in preparation methods indicates that traditional and external applications, depending on the nature of the condition being treated.

Among the reported therapeutic categories, respiratory disorders represent an important area of traditional applications. Seed preparations have also been traditionally associated with digestive and cardiovascular uses, including emetic, irritant and stimulant effects and applications aimed at reducing congestion and promoting cardiovascular health. These traditional applications may be related to the pungent and biologically active

constituents present in *B. nigra* seeds; however, traditional claims should not be interpreted as evidence of clinical efficacy without appropriate pharmacological and clinical validation.

A particularly broad range of applications is grouped under the miscellaneous category, including traditional treatment of neuralgia, rheumatoid arthritis, migraine, epilepsy, headache, toothache, neck pain, wounds, seizures and paralysis, as well as applications related to brain and lung oedema, snake and scorpion bites and diuretic use. The external application of seed-derived preparations, including oil-alcohol lotion and plaster preparations, further highlights the versatility of the plant in traditional medicine. In addition, seed extract has been reported for the management of malaria fever, including its historical use in infectious or febrile conditions. Collectively, these reports suggest that *B. nigra* possesses a broad ethnomedicinal profile. Nevertheless, the evidence presented in ethnomedicinal literature is predominantly based on traditional knowledge and historical reports, and therefore requires systematic pharmacological investigation to establish the mechanisms, active



constituents, effective doses and safety of these applications.

The convergence of traditional applications with the documented presence of phenolic acids, flavonoids and the other bioactive constituents provides a rational basis for further investigation of *B. nigra*; however, phytochemical standardization, mechanistic pharmacology and well-designed in vivo and clinical studies are required to establish a definitive relationship between its traditional uses and therapeutic potential.

8. Pharmacological Activities:

Numerous experimental studies have demonstrated that *Brassica nigra* exhibits diverse pharmacological activities [31]. Extracts of the plant possess antioxidant [32], antimicrobial [33], and anti-inflammatory, analgesic, antidiabetic, antihyperlipidemic [34] and anticancer potential. These biological effects are mainly attributed to its glucosinolates, isothiocyanates and phenolic compounds. Although preclinical findings are promising, further clinical studies are required to

confirm its efficacy and safety in human. The pharmacological profile of *brassica nigra* is diverse, with experimental studies reporting antiepileptic, antidiabetic, Hepatoprotective, Nephroprotective, antibacterial, antifungal, anticancer, antimalarial, analgesic, anti-inflammatory, anthelmintic, antitumor, anti-Alzheimer's, antioxidant and antiproliferative activities. The available evidence encompasses different plant parts, although the seeds are the most extensively investigated, followed by leaves and flowers. Aqueous, hydro alcoholic, ethanol, methanol, foxed-oil, essential-oil and other solvent extracts have been evaluated using both animal models and cell-based or microbiological systems. In particular, animal studies involving mice and rats provide preliminary evidence for neurological, metabolic, hepatic, renal, analgesic and anti-inflammatory effects, whereas antimicrobial studies have evaluated activity against bacterial and fungal organisms. This broad pharmacological spectrum is consistent with the chemically diverse composition of *B. nigra*, particularly its phenolic acids, flavonoids, volatile constituents and other secondary metabolites.

Table no.3: Pharmacological Activity of *Brassica nigra*.

Pharmacological activity	Plant parts	Extract	Test organism	References
Antiepileptic	Seeds	Hydro-alcoholic Ethanol extract	Mice Rat	[35][36] [37]
Antidiabetic	Seeds	Aqueous extract	Rat	[36][38]
Hepatoprotective Nephroprotective	Seeds Leaf	Aqueous extract Methanol extract	Rat Rat	[36][38] [39]
Antibacterial	Seeds	Oil extract with ethanol and acetone	<i>B.cereus</i> , <i>S. aureus</i> and Salmonella,	[40]
	Seeds	Ethanol extract	<i>S. aureus</i> , <i>E. Coli</i> , <i>C. albicans</i>	[41]
	Seeds	Oil extract	<i>S. aureus</i> , <i>E. Coli</i>	[42]
Antifungal	Leaves	Essential Oil.	<i>Aspergillus-niger</i> , <i>Aspergillus ochraceus</i> <i>Penicillium citrinum</i>	[43]
Anticancer	Seeds	Ethanol extract	A549 and H1299 human cell line	[44]



Antimalarial	Seeds	Methanol extract	Mice	[30]
Analgesic	Seeds	Aqueous and ethanol extract	Rat	[45]
Anti-inflammatory	Seeds Leaf	Aqueous, ethanol, methanol extract	Rat	[36][39] [45] [46][47]
Anti-anthelmintic	Flowers Seeds	Methanol extract Aqueous extract	Earthworms	[36][48]
Antitumor	Flowers	Methanol extract	Mice	[48]
Anti-Alzheimer's	Seeds	Fixed oil	Rat	[49]
Antioxidant	Areal part, Shoot root Leaves	Ethanol extract	DPPH Assay	[50][51]
		Methanol extract Acetone, methanol, chloroform, benzene extract	DPPH Assay	[52]
	Seeds	Ethyl acetate, Methanol, hexane extract	DPPH Assay	[53]
		Water, acetone, methanol extract Methanol extract	DPPH, ABTS Assay	[54]
	Seeds		DPPH Assay	[55]
Antiproliferative	Seeds	Hydro-alcoholic extract	Mice	[56]

Neurological and metabolic activities have been reported predominantly for seed preparations. Hydro alcoholic and Ethanolic seed extracts have demonstrated antiepileptic activity in mice and rats. [35-37] Seed and leaf extracts have also been evaluated for Hepatoprotective and Nephroprotective effects, suggesting potential protective activity against experimentally induced tissue injury [36-39]. In addition, aqueous and Ethanolic seed extracts have been reported to possess analgesic [45] and anti-inflammatory properties [45-47], while methanolic preparations of flowers and seed extracts have demonstrated anti-rheumatic/ anti-inflammatory potential in experimental models. Traditional applications of *B. nigra* for pain, inflammation, neurological disorders and other ailments therefore show some correspondence with experimentally investigated pharmacological effects. Nevertheless, these finding should be interpreted as preclinical evidence, and further studies are necessary to

establish the responsible constituents, molecular mechanisms, dose-response relationships and safety profiles.

The antimicrobial potential of *B. nigra* has also received considerable attention. Seed-derived oil, ethanol, acetone and related extracts have been evaluated against bacterial species including *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans*, [40-42] while leaf essential oil has been investigated against fungal organisms including *Aspergillus niger*, *Aspergillus ochraceus* and *Penicillium citrinum*. [43] The reported antibacterial and antifungal activities indicate that both polar and non-polar preparations may contain bioactive constituents with antimicrobial potential. In addition, methanolic seed preparations have been investigated for anthelmintic effects. [36,48] These findings are particularly relevant when considered alongside the traditional use of *B. nigra* preparations for infections, wounds and other



conditions; however, difference in extraction procedures, test organisms and experimental protocols make direct comparison of activity across studies difficult.

Importantly, recent pharmacological investigations also indicate anticancer, antitumor and antiproliferative potential. Ethanol seed extract ^[44] has been evaluated against human cancer cell lines including A549 and H1299, while methanolic flower extract has been investigated for antitumor activity in experimental models ^[48]. The fixed oil of seeds has additionally been examined in relation to Alzheimer's disease-related activity ^[49]. Antioxidant activity is among the more frequently investigated properties, with aerial parts ^[50-51], shoots, roots, leaves and seeds evaluated using chemical assays such as DPPH and ABTS. ^[52-56] The occurrence of phenolic compounds such as gallic acid, caffeic acid, chlorogenic acid, ferulic acid, sinapic acid and rutin, as summarized in Table no. 1, provides a plausible chemical basis for at least part of the antioxidant potential. However, antioxidant assay results obtained from chemical radical-scavenging systems should not be directly equated with therapeutic antioxidant effects in-vivo. Overall, the pharmacological literature supports *B. nigra* as a promising source of bioactive phytoconstituents, but standardized extracts, compound-level studies, mechanistic investigations, toxicity evaluation and appropriately designed in vivo and clinical studies remain necessary to substantiate its therapeutic potential.

RESULT AND DISCUSSION

Traditional plant based medicines have several claims with or without scientific proof for the treatment of cancer and viral diseases. They however put forth a great deal of importance to the people living in developing countries and also lead to the discovery of new drug candidates for a variety of diseases that threaten human health.

Conventional drugs used in the treatment of the cancer are inadequate and can have serious adverse effects. Due to their many biological and therapeutic properties, greater safety margins, and lower costs, herbal medicines are much sought after for primary healthcare in both developed and developing nations.

Based on ethno medicinal information and literature surveys, *Brassica nigra* was selected for the present work. The literature surveys has revealed that *brassica nigra* traditionally used as anticancer and antiviral. Although several in-vitro and in-vivo reports indicate various *Brassica* species, their important constituents, possess different pharmacological efficacy. Further, there are no reports on isolation and characterization of active chemical components and investigation of the efficacy of these plants and their compounds against antioxidant and anticancer activity. Thus the present work aims to investigate the effect of different extracts of *brassica nigra* and its isolated compounds.

CONCLUSION

This ethno-medico botanical study on the plant *B. nigra* has revealed the diversity of its medicinal and traditional use. *B. nigra* used for a wide range of ailments like cough, cold, fever, bronchitis, arthritis, malaria fever, hepatic, neurodegenerative diseases. Either the whole plant or a part of plant, singly or in-combination with other plant material. Potential medicinal drugs now days are derived from plant origin. Traditional medicines are used worldwide due to their safety, efficacy, low cost and availability. So there is need to investigate traditional plants for their therapeutic efficacy and screen the Phytoconstituents for active principles. Then validation of use of folk medicine should be done.

In recent years, there has been increasing interest in investigation of the traditional uses of *B. nigra*. The modern pharmacological studies confirmed



the therapeutic importance of *B. nigra* i.e. antimicrobial, antidiabetic, anti-inflammatory, anticancer, Hepatoprotective, neuroprotective, etc. In the present day, folk knowledge system in our country is fast eroding and there is an urgent need to inventoried, record all ethnobotanical and traditional information among the diverse ethnic communities before it lost. The collective database on ethnomedicinal uses of plants will be informative for future generations to work further.

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