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# A Review on Geographical and Pharmacological Distribution of Brassica Oleracea

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## ABSTRACT

**Background: White cabbage, scientifically known as Brassica oleracea var. capitata f. alba, is a cruciferous vegetable that has long been valued for its culinary and medicinal uses. For the treatment of numerous illnesses, such as diabetes, cancer, inflammation, hypertension, hypercholesterolemia, bacteria, oxidation, and obesity, various preparations derived from various portions of the plant, including roots, shoots, leaves, and the entire plant, are utilized.**
**Objective: Botany, distribution, traditional applications, phytochemistry, and pharmacological properties of B. oleracea var. capitata are all going to be assessed in this review. In addition, the gaps in knowledge will be filled and new research opportunities in pharmacology will be highlighted by this review.**
**Method: Through an internet search of internationally recognised scientific databases, a variety of resources were gathered to gain a comprehensive understanding of Brassica oleracea var. capitata. These resources included research papers, reviews, books, and reports.**
**Results: Alkaloids, flavonoids, organic acids, glucosinolates, steroids, hydrocarbons, and about forty-nine other phytochemical components of Brassica oleracea var. capitata have been culled from various sources. Bactericidal, antioxidant, anti-inflammatory, antibacterial, anti-obesity, anticoagulant, hepatoprotective, and anticancer are only a few of the pharmacological activities exhibited by crude extracts and phytoconstituents of Brassica oleracea var. capitata. Here you may find a complete inventory of the phytochemical components and pharmacological information pertaining to Brassica oleracea var. capitata.**
**Conclusion: Results showed that Brassica oleracea var. capitata is a significant medicinal plant with multiple pharmacological effects, and the study also looked at its phytochemistry, traditional applications, and pharmacological activity. Our goal in conducting this assessment of this plant was to bridge knowledge gaps in the field and lay the groundwork for future studies and medication development. While researching Brassica oleracea var. capitata, we did find a number of significant traditional applications and pharmacological properties.**

***Keywords-*** Brassica oleracea var. capitata f. alba; Brassicaceae; antioxidant.; cabbage; pharmacological activity; phytochemistry; traditional uses.

## I. INTRODUCTION

The cultivated varieties of Brassica oleracea L., which are frequently referred to as "brassica vegetables" or "cole crops," are characterised by an exceptional diversity of morphological forms and share a common C-genome that is composed of nine chromosomes[1-2]. These must have differentiated as a result of human

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selection, beginning with a simple leafy type (leafy kale, var. viridis L.) and progressing to a variety of highly valued modifications. These modifications include the arrest of development and the enlargement of the inflorescences in broccoli (var. italica L.) and cauliflower (var. botrytis L.), the folding of the leaves into 'heads' in cabbage (var. capitata L.), the enlargement of the basal stem in kohlrabi (var. gongylodes L.), thickened stems in marrow-stem kale (var. medullosa Thell.), proliferation of heading buds in Brussels sprouts (var. gemmifera (DC.) Zenker), and so on.[3-4] The n = 9 C-genome is shared by a number of wild forms that are primarily found growing on steep cliffs that overlook the Mediterranean Sea (more than ten species, with several endemisms) or the European West Atlantic coasts (B. oleracea L. subsp. oleracea)[5].These wild forms can be grouped together with the domesticated forms to form a homogeneous interfertile group that is also known as the "B. oleracea group or cytodeme" or the "Brassica Section Brassica." The domestication process that resulted in the cultivated varieties of B. oleracea L.[6-9] has not been completely clarified, either in terms of its initial location or the progenitor species that were involved[10]. All of the n = 9 wild Brassica species that have a C-genome have been deemed to be candidate wild progenitors[11]. This is because they have the ability to intercross with cole crops for breeding purposes. Prior to the year 1990, which is to say before the first relevant results of molecular genetics were obtained, a polyphyletic view was prevalent regarding the domestication of the cole crops. B. oleracea subsp[12-14]. oleracea was considered to be one of the ancestors, while other Mediterranean species were likely involved in the origin of some of the cole crops[15-17]. An examination of nuclear restriction fragment length polymorphisms (RFLP) led to the conclusion that wild Brassica oleracea subsp. oleracea appeared to be the most closely related to cultivated forms and, consequently, the most closely related to the ancestors of all cultivated Brassica oleracea[18-20]. On the other hand, other wild Brassica species that were distributed in the Mediterranean region were found to be more distantly related[21]. It has been hypothesised that the initial domestication of this taxon (B. oleracea subsp. oleracea) took place on the Atlantic coast, and that early cultivated forms were brought from there to the Mediterranean, where selection for many of the early crop types took place[22]. This is due to the fact that this taxon is only found on West European Atlantic cliffs in Britain, France, northern Spain, and the German Islands of Helgoland and Rugen (and was formerly also found in Ireland)[23-25]. More recently, it was argued that linguistic and literary considerations would lend support to the idea that a Mediterranean domestication would be supported by linguistic and literary considerations[26] This is due to the fact that Greek and Latin literature, from their earliest traces, are abundant in terms that indicate a profound understanding and utilisation of the B. oleracea crops. On the other hand, there is no evidence of B. oleracea in any other early historical sources, including those from the Fertile Crescent, ancient Egyptian civilizations, or Celtic civilizations[27][28][29][30]. There have been a number of authors who have searched for literary or iconographic accounts of B. oleracea in the past. Their goal was to gain a better understanding of the genesis of the related crops, as well as their diversity and the usage they have experienced in the past. Etymology and the quest for the earliest accounts of B. oleracea in literature were the primary focuses of the studies that came before it was primarily focused on[31].The purpose of this study is to provide a more systematic examination of ancient Greek and Latin literature. The objective is to provide a more thorough, if not exhaustive, description of the references made to B. oleracea[32-35]. These references range from the earliest Greek fragments from the sixth century B.C.E. to Latin works from the fourth century C.E. During the time period under consideration, the many varieties of cole crops that were in existence, as well as the agricultural practices and culinary and medicinal applications that corresponded to them, are discussed[36-38]. This work not only makes an addition to the body of ethnobotanical knowledge concerning the ancient Greek and Latin world, but it also lends credence to the idea that the domestication of B. oleracea took place in the Mediterranean region[39-40]. Multiple studies have demonstrated that the genetic background of these populations is extremely closely related to that of cultivated B. oleracea crops. As a result, these populations are able to easily intercross with cultivated B. oleracea crops, which have higher fertility rates than any of the wild relatives of the cole crops that are native to the Mediterranean region and have the same chromosome number, which is 2n = 18[41-43]. This pattern has been viewed by a few scholars as a valid indicator that the vegetable brassica crops originated in the Atlantic Ocean[44]. For a variety of reasons, including historical, linguistic, literary, and other concerns, this interpretation has been called into question by various authors[45]. Regardless of where they originated, the wild populations of Brassica oleracea that are found in the Atlantic region demand special attention because of their capacity to interbreed with other crops that are related to them. In light of the fact that they are a part of the primary genepool of Brassica oleracea crops, it is important to investigate their diversity because it has the potential to provide helpful alleles that may be absent from the genepool of cultivated plants[46]. Because of this, it is essential to create an accurate map of the distribution of these populations, as this is a critical step towards the preservation of valuable variety, and it is also essential to examine the nature and structure of such diversity[47-50] The map and the phytosociological investigations of particular populations have been the primary sources of information regarding the distribution of the French populations up until this point[51-55].Through the course of our research, we were able to locate and collect samples from an incredible number of people, some of which were

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reported for the very first time. Our study investigated the coastal regions of the northwestern region of France[56][57]. In terms of genetic study, there have only been a relatively small number of wild-growing populations of B. oleracea from France that have been researched in the past Isozymes [58]. were used to estimate the diversity of four different populations. The Random Amplified Polymorphic DNA (RAPD) technique is used to determine the genetic diversity of two populations (from Mers-les-Bains and Mortagne for example). With the exception of the Mortagne population, which was the lowest in size (about 550 people) and had lesser diversity in the isozyme study, they discovered a significant amount of intrapopulation variety. Only the Mortagne population was the exception[59].The four French populations also demonstrated a significant amount of genetic variety between populations (Gst = 0.39), with intermediate values in comparison to the lower values that were found between three Spanish populations (Gst = 0.11) and the higher values that were found between eleven British populations (Gst = 0.51). The fact that groups from the same or even adjacent locations did not cluster together provided evidence that genetic diversity and geographical dispersion behaved independently of one another[60]. In the study conducted by Lanneier-Herrera et al. in 1996, it was found that there was no significant association between the degree of gene diversity and the size of the population. There are other studies that only comprise one or two accessions that are evaluated for comparisons within multi-species sets. These research are regarding French populations. High levels of Nei's genetic diversity H were found, with values ranging from 0.18 to 0.33 across the various populations. Additionally, they found significant differentiation between populations, with a Fst value of 0.2257 across 103 loci. On the other hand, there was not found to be any significant correlation between genetic distance and geographic distance[61].

## II. MATERIAL & METHODS

In order to acquire comprehensive information about Brassica oleracea var. capitata, a number of materials, such as research papers, review papers, books, and reports, were gathered. These resources were obtained by doing an online search of scientific databases that are recognised all over the world. The software known as Biorender was utilised to create the structures and figures of the phytochemical ingredients.

***Geographical Distribution***

Flowering plants have undergone polyploidization in a significant and frequently recurrent manner over their evolution. In addition to adding to the complexity of the genome, the duplicated sections that are formed as a result, particularly those that were produced relatively recently, provide the opportunity to do additional research on the contributions of segmental and/or whole-genome duplication/triplication to the evolution of a lineage. An further factor that contributes to the complexity of the genome is the high content of repetitive DNA sequences seen in certain flowering plants. Many plant genomes have been sequenced or are currently being sequenced at this time. It is possible for draft genome sequences to lack sufficient contiguity in many genomic areas to permit cross-species comparisons of genome organisation and structure. This is an essential step in the process of comprehending plant evolution and speciation. Independent physical maps, when used in conjunction with sequence assemblies, frequently make it easier to correctly place DNA segments on chromosomes, which in turn clarifies the changes in genome organisation that are revealed by comparisons across several species [61].

Brassica is a member of the Brassiceae tribe, which is a well-defined clade within the Brassicaceae family. This clade also contains Arabidopsis thaliana, which was the source of the first flowering plant genome to be sequenced. Brassica and Arabidopsis are believed to have shared a common ancestor approximately 14 to 20 million years ago [62]. The genus Brassica is of significant value in both the scientific and commercial fields [63]. The crops that belong to the genus Brassica are utilised extensively in the culinary traditions of numerous civilizations and are the primary source of edible vegetable oil supplies across the globe. Among the six species of Brassica that are frequently grown, there are three diploids: B. rapa (AA, 2n = 20), B. nigra (BB, 2n = 16), and B. oleracea (CC, 2n = 18). Additionally, there are three amphidiploids (allotetraploids): B. juncea (AABB, 2n = 36), B. napus (AACC, 2n = 38), and B. carinata (BBCC, 2n = 34).

The investigation of B. oleracea holds a particularly high potential for revealing novel insights into the evolution of morphology, which will both supplement and expand upon the information that is now available in Arabidopsis [64]. It has been observed that the rate of morphological divergence in B. oleracea has been extremely quick in comparison to the rate of reproductive isolation. This means that this single species possesses a staggering variety of morphologies among genotypes that are easily crossing over. The domestication of the majority of crops led to the improvement of a specific plant part for human use, such as the seeds or grains of cereal crops, the fruits of some trees, or the roots of certain vegetable crops. However, the B. oleracea crops represent a notable exception to this rule. They include forms that have been selected for enlarged vegetative meristems at the apex (cabbages, B. oleracea subspecies capitata) or in the leaf axils (Brussels

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sprouts, subsp. gemmifera), forms with proliferation of floral meristems (broccoli, subsp. italica) or even aborted floral meristems (cauliflower, subsp. botrytis), and forms with swollen bulbous stems (kohlrabi, subsp. gongylodes), or orate leaf patterns (kales, subsp. acephala). There is no restriction on the intercrossing of these physically distinct genotypes, often known as "morphotypes."

The versatility of B. oleracea makes it a viable model for the study of plant morphological evolution. This is comparable to the way that the dog (Canis spp.) is an interesting model for the study of the evolution of mammalian species. Some Brassica morphologies are assumed to be controlled by a small number of genes, such as the homologs of Arabidopsis mutants, such as "CAULIFLOWER" [15-17]. However, these morphologies are subject to a complicated genetic control [65]. Some of the QTLs in Brassica map to places that correspond to relevant Arabidopsis mutants, which suggests that they are positional candidates. However, many of the QTLs do not map to these regions, which suggests that there is the possibility of identifying functions that are resistant to mutation in Arabidopsis [66] or that escaped detection due to modest phenotypic effects.

The comparative genomics of Brassica and Arabidopsis promises to reveal genetic determinants of a considerably wider spectrum of variation than may be accessible using Arabidopsis alone [67]. This is because of the strong evolutionary link between the two species. Low-coverage (0.6×) sequencing of the B. oleracea (BO) genotype TO 1000 was sponsored by the National Science Foundation (NSF) [68]. This was driven by the tight link between Brassica and Arabidopsis. Nevertheless, despite the fact that Arabidopsis and Brassica share similarities in terms of their physiology and developmental biology, the genomes of Brassica species are found to be significantly more complicated than those of A. thaliana [69]. The genomes of the 'diploid' Brassica species are three to five times larger than those of Arabidopsis. The differences in size range from 0.97 pg/2C (468 Mb/1C) for Brassica nigra to 1.37 pg/2C (662 Mb/1C) for Brassica oleracea. This is mainly due to the fact that their ancestors undergoes numerous rounds of polyploidy [69]. Before the break between Arabidopsis and Brassica, there was a round of ancient whole-genome triplication (gamma) in an early eudicot progenitor, as well as two rounds of whole-genome duplication (beta and alpha) [70]. Additional polyploidizations took place in the Brassica lineage after it diverged from Arabidopsis. These polyploidizations are evidenced by extensive duplicated portions in the genomic maps of each of the three diploids, which are B. rapa (syn. rapa), B. nigra, and B. oleracea [71]. According to the similar duplicated structure of the B. rapa and B. oleracea maps, the divergence of the species occurred after polyploidization, which led to the triplication of the entire genome.[72] Between 7.9 and 14.6 million years ago, it was estimated that the genome triplication event and the initial diversification of the Brassiceae must have taken place. This event could be the single and major evolutionary event that has been hypothesised to have given rise to the early lineages [73]. According to the findings of the investigation of the FLOWERING Locus C area, it was further estimated that the Brassica triplication took place between 13 and 17 mya, almost immediately following the divergence of Arabidopsis and Brassica, which took place between 17 and 18 mya.

There have been significant advancements achieved in the process of generating genomic resources in order to speed up research on Brassica [41-44]. With an average distance of 2.4 cM between markers, a comprehensive genetic linkage map of B. rapa has been produced [45]. This map has 545 sequence-tagged loci that are spread out among 10 linkage groups that encompass a total of 1287 cM. The genetic linkage maps were constructed for four populations of B. oleracea, each of which had an average length of 863.6 cM. A total of 367 loci were found in the composite map that was constructed, with an average interval between loci of 2.35 cM [33]. These loci revealed at least 19 chromosomal rearrangements that differentiated B. oleracea from Arabidopsis. The development of linkage maps of immortal mapping populations of quick cycling, self-compatible lines from B. rapa and B. oleracea occurred not too long ago [46]. These linkage maps included 224 and 279 markers, respectively. The high-information-content fingerprinting (HICF) method [44] was utilised to create a genome-wide physical map of the B. rapa genome. This method allows for better physical map production in terms of both throughput and quality by utilising the fluorescence-labeled finger-printing methodology. With the use of the map, 242 anchored contigs were located on ten different linkage groups. These contigs were intended to act as seed places from which bidirectional chromosome extension could be continued for genome sequencing. Additionally, there are attempts being made to improve genetic linkage maps. Both the "A" and "C" genomes are now being sequenced as part of ongoing or proposed genome sequencing studies [47,48]. The objective of the Brassica rapa Genome Sequencing Project (BrGSP) and the Multinational Brassica Genome Project (MBGP) is to thoroughly sequence the genome of the Brassica rapa inbred line known as "Chiifu."

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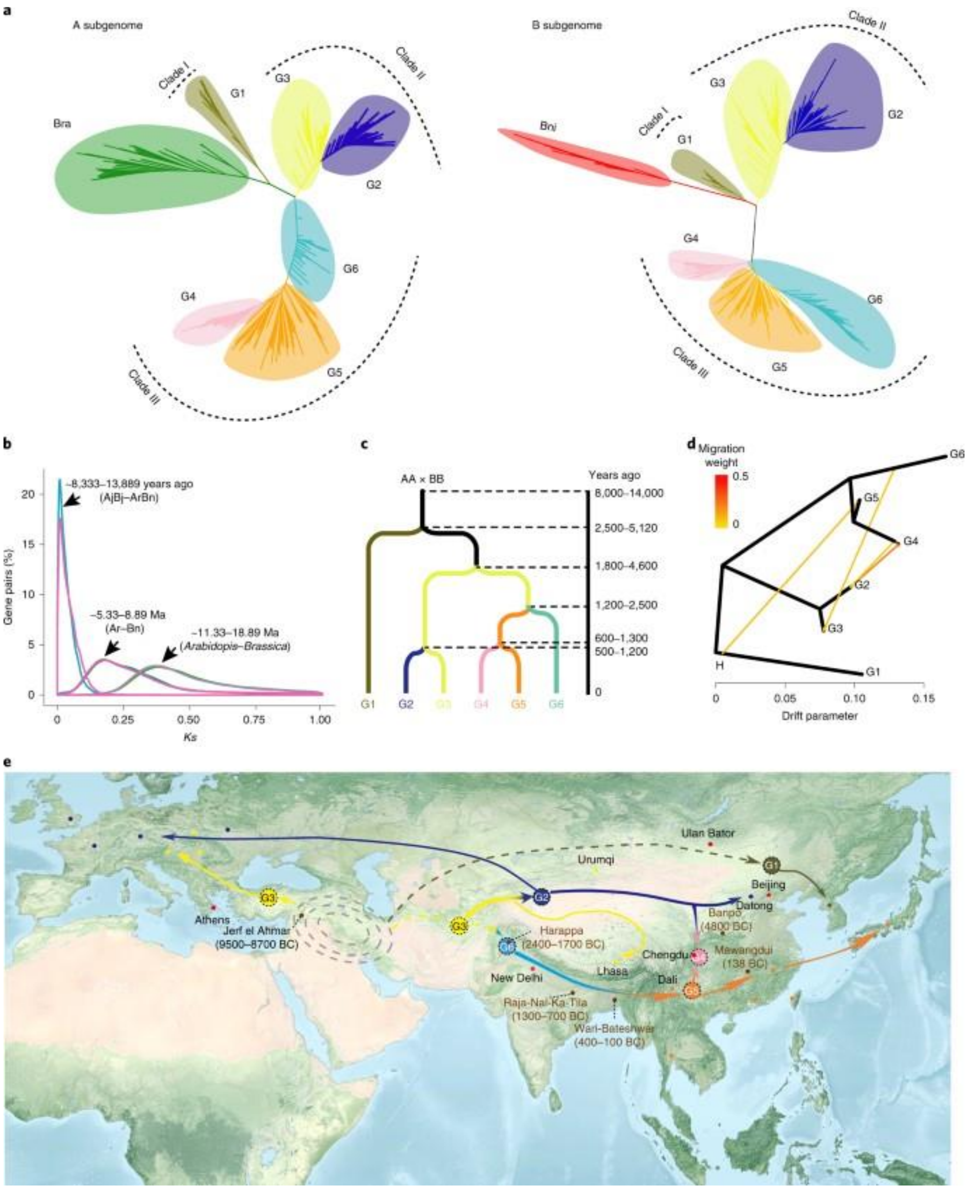


**Fig: 1 a, Maximum-likelihood phylogenies of the subgenomes of 390 *B. juncea* accessions compared to *B. oleracea* (left), accessions (right). b, Estimates of molecular divergence between *B. juncea* (AjBj) and its pseudo-ancestor (ArBn, pooled by two progenitors, *B. oleracea* ). c, Divergence time for six groups was estimated using SMC++. d, Detection of gene flows *B. oleracea* groups by Tree Mix analysis. Arrows represent the direction of migrations. Horizontal branch length is proportional to the amount of genetic drift that has occurred on the branch. Scale bar shows ten times the average standard error of the entries in the sample covariance matrix. e, Putative spread routes of *B. juncea*. Archaeological evidence showing that seed cakes or carbonized mustard seeds were excavated from Jerf el Ahmar (9500–8700 BC), Banpo site (about 4800 BC), Harappa (2400–1700 BC), Raja-Nal-ka-Tila site (1300–700 BC), Wari-Bateshwa (400–100 BC) and Mawangdui site (about 138 BC. The geographic map was adapted from NASA.**

***Pharmacological Activity***

Brassica vegetables have been shown to possess a variety of biological properties, including antibacterial, anticancer, and antiviral properties. Furthermore, these veggies operate as a powerful modulator for the innate immune response system.[74] The crude extracts of therapeutic plants are utilised extensively on a home basis in rural areas, according to traditional medical systems such as Chinese and Unani medicine. Culture has been used to cultivate the majority of cruciferous plants since ancient times. The Mediterranean basin is the natural habitat of these plants, and the local markets provide a significant amount of demand for them.Fifty There are numerous regions across the world that use vegetables belonging to the Brassicaceae family as a stable food source. These vegetables are considered to be an excellent source of amino acids, minerals, carbohydrates, vitamins, and several groups of phytochemicals.[75]. These plants

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are incorporated into comprehensive breeding programmes as a source of value-added features of agronomic relevance. The goal of these programmes is to improve the phytochemicals that have positive effects on health and to make the plants resistant to herbicides, insects, soil pests, and diseases.49th The consumption of cruciferous vegetables has been suggested by a number of epidemiological studies and meta-analyses to be an effective method for preventing a variety of malignancies and chronic diseases.21. It is estimated that approximately 64 percent of the total population of the world relies on traditional medicine for their health care system. On the other hand, in India, 85 percent of the rural population relies on plants for the treatment of a variety of diseases.There are ten types of plants that are considered medicinal because they contain active components that are utilised in the treatment of a variety of ailments. To put it another way, plants recognised for their curative qualities are referred to as medicinal plants.111 Over the past few years, brassica has gained more attention as a potential trap crop. These trap crops are positioned in such a way as to attract and capture the insects that are being targeted, hence reducing the amount of main crops that are lost due to pest damage.[76]. Myrosinase is an enzyme that is found in all glucosinolate-containing vegetables that belong to the Brassicaceae family. This enzyme is responsible for enhancing the hydrolysis of glucosinolates into aglycone and D-glucose. Additionally, aglycones are transformed into indoles or isothiocyanates. Active forms of glucosinolates have been shown to have a variety of positive effects on human health.21. In the current research in the field of plant biology, plants belonging to the Brassicaceae family are being utilised as a model plant. Among these plants, Arabidopsis halleri is being employed for the hyperaccumulation study. Plant architecture is affected by Cardamine hirsuta, modifications in the mating system are caused by Diplotaxis spp., and seed physiology is affected by Lepidium spp.a 17 According to the findings of a number of studies, the region of Irano-Turania, which has the potential to be the place of origin for the family Brassicaceae, is home to the greatest diversity of Brassicaceae species. The ages of the members in the family are not yet known. Estimates of the ages of Brassicaceae are dependent on the date of the duplication of the genome in Arabidopsis, which is estimated to have occurred between 24 and 40 million years ago.a 17 Within the scope of this review paper, the primary emphasis of our research was on the information concerning the pharmacological actions of plants belonging to the Brassicaceae family.[77-80]

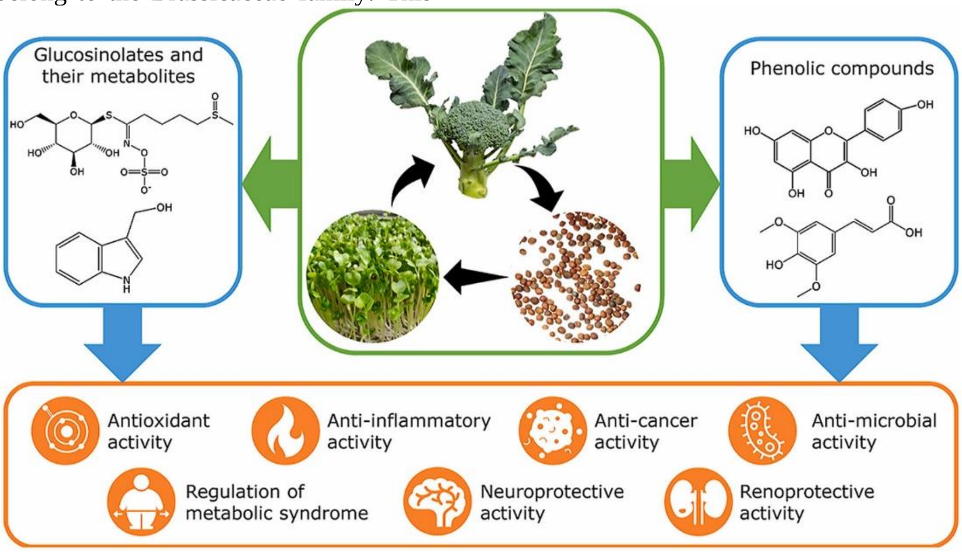


**Fig: 2 Chemical Constituents of *Brassica oleracea* shows *Pharmacological Activity***

***Brassica Species With their Pharmacological Activity***

**Table 1: List of Plants from Brassicaceae family with Pharmacological activities**

| S. No | Botanical name | Common name | Parts used | Pharmacological activity | References |
|---|---|---|---|---|---|
| 1. | *Brassica rupestris* L. | Brown mustard | Whole plant | Anticancer and antioxidant activity pathogens Potentialas new edible oil/protein crops | 1 |
| 2. | *Brassica tournefortiiGouan* | Asian mustard | Whole plant | Anticancer and antioxidantactivity | 1 |
| 3. | *Brassica napus* L. | Rapeseed | Whole plant | Anticancer, antioxidant, | 1,2,22 |

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| | | | | analgesic, diuretic and Anti- catarrhal activity, Diuretic, anti- scurvy, anti-inflammatory of bladder and anti-goat | |
| 4. | *Brassica* L. *var. perviridis* | Mustard spinach | Whole plant | Anticancer and antioxidantactivity | 1 |
| 5. | *Brassica rapa*L. *var. rapifera* | Turnips | Whole plant | Anticancer and antioxidantactivity | 1 |
| 6. | *Brassica rapa*L. *var. chinensis* | Bokchoy | Whole plant | Anticancer and antioxidantactivity | 1 |
| 7. | *Brassica rapa*L. *var.pekinensis* | Chinese cabbage | Whole plant | Anticancer and antioxidantactivity | 1 |
| 8. | *Brassica oleracea* | Cauliflower | Leaves | Antibacterial activity | 23 |
| 9. | *Brassica carinata* A. Braun. | Ethiopian or Abyssinian mustar | Whole plant | Used as bio-fumigant, tosuppress soil-borne pests and | 2,24 |
| 10. | *Malcolmiaafricana (L.) R.Br.* | African mustard | Spices | Antioxidant activity and phenol content | 25 |
| 11. | *Brassica oleracea* L. *var.capitata* | Cabbage | Raw and processed Cabbage | Antioxidant, anti-inflammatory and antibacterial properties | 6,23 |
| 12. | *Brassica rapa* L. | Broccoliraab | Vegetables | Anticancer, diuretic, analgesic, anti-gout potential, aphrodisiac activity, anti-inflammatory and anthelmintic activity<br>Improve insulin resistance in type2 diabetic patients | 1,26,27 |
| 13. | *Brassica oleracea var. capitata f.rubra* | Red cabbage | Leaves | Anti-diabetic, antioxidant, hypolipidemic, antihyperglycemic, cardioprotective and anti-cancer activity | 7 |
| 14. | *Brassica juncea* L. | Mustard | Seed<br><br><br><br>Leaves<br><br><br>Dried leaf and flower<br><br>Total plant | Anticancer, anti-diabetic, diuretic, analgesic, emetic activity and rubefacient<br>Antihyperglycemic, antioxidant, antiatherogenic, antifungalactivity, allergenicity andantitumor activity<br>Antiatherogenic effect,anti-oxidant and fungicidal activity<br>Used to treat dengue fever, splenic disorders and dyspepsia | 1,2,28–30 |
| 15. | *Brassica campestris* Linn. | Sarson | Seed Oil | Used to remove dandruff from hair, Used as Ointment in skin diseases masses, laxative and hair tonic | 31 |
| 16. | *Raphanus sativus* | Radish | Leaves and seeds<br><br>Undergroun dparts | Antimicrobial activity<br><br>Treatment of intestinal parasites, asthma and chest pain. | 23,32,33 |
| 17. | *Lepidium Sativum* L. | Garden cress | Seeds | Used in treating dysentery andbone fracture<br>Healing in human and migraine Used as a saag and anthelminticAnti-arthritic activity<br>Useful in the treatment of asthma, | 34–37 |

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| | | | | cough with expectoration, poultices for sprains, leprosy, skin disease, dysentery, diarrhoea, splenomegaly, dyspepsia, lumbago, leucorrhoea, scurvy and seminal weakness | |
| 18. | *Nasturtium Officinale R.BR.* | Watercress | Vegetative shoot | Used as pot herb and salad, its decoction and ”Saag’’ is used as appet as appetizer, stomach, anticobic, diuretic and also used in chest problem. | 34 |
| 19. | *SisymbriumIrio* L. | London rocket | Leaves and seeds | Antipyretic, anti-vomiting, diarrhea and cough. | 34,38 |
| | | | Whole plant | A tonic herb with a mustard-like aroma. It has laxative, diuretic, and expectorant effect, and benefits the digestion, internally used for bronchitis, coughs, laryngitis and bronchial catarrh. | |
| 20. | *Brassica nigra* | Black mustard | Seeds | Anticancer, anti-diabetic, diuretic, stimulant activity, activity in cold and flu, anti- catarrhal, emetic, antibacterial activity and laxative.<br>Anti-spasmodic, aphrodisiacactivity, appetizing, digestive and aperitif activity<br>Used against alopecia, Anti-dandruffactivity,<br>Used in neuralgia<br>Used for common cold andarthritis | 1,2,39,40 |
| 21. | *Armoracia rusticana* | Horseradish | Roots and leaves | Anti-lipase and antioxidantactivity | 41 |
| 22. | *Calepinairregularis* | White ball mustard | Mustard extracts | Analgesic activity | 2 |
| 23. | *Lepidium meyenii* | Maca | Leaves | Restores the levels of testosterone in the males<br>Hypoglycaemic and anti-obesity effect | 42 |
| 24. | *Brassica indica* | - | Whole plant | Used in fertility regulation | 43 |
| 25. | *Anastaticahierochuntica* Linn. | Rose of Jericho | Whole plant | Used in fertility regulation | 43 |
| 26. | *Capsella bursa-pastoris Moench* | Bambaisa | Whole plant<br>Seeds | Used in fertility regulation<br>Astringent | 20,43 |
| 27. | *CheirantusCheiri* L. | Wallflower | Flower and seed | Diuretic, aphrodisiac, jaundice, tumors | 43,54 |
| 28. | *Aethionemaoppositifolium Pers.& Hedge* | Opposite-leaf candytuft | Spices | Antioxidant activity | 25 |
| 29. | *Cardamine Hirsuta* Linn. | Hairy bittercress | Whole plant | Used for indigestion | 44 |
| 30. | *Rorippa Indica* (Linn.) Hiern | Indian yellow cress | Whole plant | Used for a toothache, sore throat, rheumatic arthritis,hepatitis, abdominal and blood disorders | 44 |
| 31. | *DescurainiaSophia* (L.) Webb. | Skhabootay | Flowers and leaves<br>Seeds | Antiscorbic<br><br>Used as Cardiotonic, demulcent, | 20,45 |

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| | | | | diuretic, expectorant, febrifuge, laxative | |
| 32. | *Nasturtium officinale* R.Br. | Talmeera | Shoot Leaves | Purgative, emetic Effective in cough | 20,46 |
| 33. | *Alliariapetiolata (M.Bieb.)* | Garlic mustard | Leaves | Antimicrobial activities<br>Used as an antiseptic in ulcers and cuts, as a disinfectant, a diuretic and to heal wounds and bronchial complications | 2,47 |
| 34. | *Raphanus sativus var. longipinnatus* | White radius | Leaves | Antimicrobial activities | 48 |
| 35. | *Brassica alba Boiss.* | White or yellow mustard | Seedling leaves Seeds | Used to purify and strengthen the blood, It has strong disinfectant properties and is used to preserve foods, Used for the treatment of cold, cough and sore throats | 2 |
| 36. | *Sisymbriumofficinale L. Scop.* | English watercress | Whole plant | Treatment of sore throat and as an expectorant to treat common cold and asthma | 2 |
| 37. | *Nesliapaniculata* | Ball mustard | Whole plant | Used as fodder for both monogastric and ruminant livestock, skin disorders. | 2 |
| 38. | *Sisymbriumerysimoides* | Smooth mustard | Whole plant | Used to treat bronchitis and has Anti-inflammatory activity | 2 |
| 39. | *Sisymbriumorientale* | Asian hedge mustard | Whole plant | Used to treat bronchitis | 2 |
| 40. | *Sisymbrium officinale* | Hedge mustard | Whole plant | Used to treat bronchitis and Snake bite antidote<br>Anti-asthmatic, Anti-spasmodic and Anti- addiction activity | 2 |
| 41. | *Camelina sativa* | Camelina | Whole plant | Potential in the food, animal feed, nutraceutical, paint, dye, cosmetic, and biofuel industries<br>Potential as new edible oil/protein crops | 24 |
| 42. | *Crambeabyssinica* | Crambe | Whole plant | Use as erucamide<br>Potentialas new edible oil/protein crops | 24 |
| 43. | *E. vesicaria* | Rocket | Seed oil | Used as an illuminant, lubricant, hair oil, vesicant, and formassage and pickling.<br>Potential as new edible oil/protein crops | 24 |
| 44. | *Aethionema grandiflorum* | Persian stonecress | Whole plant | Used to treat meningitis, bacterial infections and typhoid | 33 |
| 45. | *Erysimumkotschyan* | Wallflower | Spices | Antioxidant activity | 25 |
| 46. | *Sterigmostemumincanum* | - | Spices | Antioxidant activity | 25 |
| 47. | *Aethionemadumanii* | - | Spices | Antioxidant activity | 25 |
| 48. | *Brassica hirta* | White mustard | extracts | Anti-microbial activity | 2 |
| 49. | *Eruca sativa* | Rocket salad | Leaves | Used as Astringent, diuretic, digestive, emollient, depurative, laxative, rubefacient, tonic, stomachic Antiinflammatory, | 18–20 |

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| | | | whole plant | Antibacterial activity, Hair tonic, antidandruff and antioxidant activity antidiabetic activity | 53 |

## III. CONCLUSION

The natural compounds that are often derived from medicinal plants have the potential to be used in the development of a wide variety of innovative therapeutic applications. Because of the high levels of fibre, vitamins, and phytochemicals that are found in the Brassicale order, the Brassicaceae family has the potential to positively impact the health care system of individuals. Brassicaceae vegetables are distinguished from other types of vegetables because their bioactive metabolites have a high concentration of sulfur-containing chemicals. It is possible for the effects on genetic pathways to be improved by those nutrients that are beneficial to the immune system, enable bone health, and also have anti-inflammatory and anticancer activities. It is therefore advantageous for both people and animals to consume these plant extracts since they have the ability to delay the oxidative damage that is associated with diseases and illnesses in vivo. Therefore, the eating of leaves belonging to the Brassicaceae family represents a naturally available food that has the potential to inhibit the growth of microorganisms. Several advantageous effects are exhibited by the compounds that belong to this family as a result of the distinct chemical characteristics and physiological functions that they exhibit within it. Further in vitro or in vivo pharmacological studies for the scheduled bioactive compounds from Brassica vegetables have demonstrated a wide range of biological activities. These activities include antimicrobial, anticancer, antimutagenic, anti-inflammatory, neuroprotective, and antioxidative activity. Additionally, some of these compounds may have the potential to have anti-nutritive effects on the human body. As a result of the family's status as an exceptional source of phytochemicals and nutrients that are helpful to one's health, these food crops are considered to be of dietary significance in the fight against specific diseases. As a result, this review offers a vast amount of information regarding the nutritional value that is present as well as the pharmacological activities that are related with the Brassica plants. As a result, it ultimately guides individuals to make healthier dietary choices.

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