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Potential candidate crops for seed spices group: Botany and Medicinal significance

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Abstract:

Seed spices and herbs have been in use for centuries both for culinary and medicinal purposes due to the presence of a wide range of volatile and non-volatile dietetic compounds.Seed spices not only enhance the flavor, aroma, and color of food and beverages, but they can also protect from acute and chronic diseases. There is now ample evidence that seed spices possess antioxidant, anti-inflammatory, anticarcinogenic, antidiabetic, antimicrobial, and other numerous medicinalproperties that affect human health and temperament. The research on seed spices has reported on a varied array of health properties that they possess via their bioactive compounds in plant parts, seeds, and roots. However, still, there is a lack of concise information pertaining to some other crops which have the potential to be used as seed spices. This review highlights the botanical description and medicinal uses of different potential seed spices such as parsley, black cumin, black caraway, Indian dill, sweet fennel, poppy, sesame and mustard.

Keywords: Black cumin, black caraway, Indian dill, mustard, parsley, poppy, sweet fennel&sesame.

Introduction:

Historically, India has always been recognized as a land of spices. International Organization for Standardization (ISO) listed a total of 109 crops as spices and among them, 63 spices are under cultivation in India. Among the 63 spices, 20 are considered seed spices and grown in India. India is the largest producer, consumer and exporter of seed spices in the world and it accounts for about 47 percent (2.12mha) of the total spice area and 19.45 percent (2.06 million ton) of total spice production in the country (Spice board, 2020-21). India exports about 24% of seed spices production to nearly 100 countries in the world and meets >50% of the global demand. Besides, fulfilling the local demand of the country, the total export of seed spices is nearly 0.482 million tonnes, which is valued at ₹5665 crores (Spice board, 2020-21) and accounts for 30.83% (in quantity) & 20.83% (in value) of total spice export from India. Arid and semiarid parts (Rajasthan and Gujarat) of India are known as Seed Spices Bowl and contribute more than 80% of total seed spices production. USA, Brazil, Malaysia, Gulf countries, UK, Pakistan and South Africa are the major importing countries of seed spices. In the coming decades, the demand for seed spices will increase nearly threefold as the population is growing rapidly and people are also getting aware of the potentiality of seed spices in health and wellness due to Covid-19 like pandemic situations. In the international market also, many other countries *viz*., Turkey, Syria and Iran are coming up as strong competitors, especially in cumin, coriander, fennel and fenugreek seed export as the bulk of their products are exported and their prices are much lower than India's. Therefore, there is a requirement to strengthen research & development activities to enhance the productivity as well as the quality of major seed spices *viz*., Cumin (*Cuminum cyminum* L.), Coriander (*Coriandrum sativum* L.), Fennel (*Foeniculum vulgare* Mill.), Fenugreek (*Trigonella foenumgraecum* L.) and Nigella (*Nigella sativa* L.), as well as minor seed spices *viz*., Dill (*Anethum graveolens* L.), Celery (*Apium graveolens* L.), Caraway (*Carum carvi* L.), Aniseed (*Pimpinella anisum* L.) and Ajwain (*Trachyspermum ammi*). Apart from research on major & minor seed spices, there are also possibilities to explore the potential of the other crops to be used as seed spices due to the presence of different bioactive compounds which have many medicinal properties, and also these crops are using for culinary purpose in different parts of the world since aegis. These crops are mainly used as adjuncts to impart flavor and aroma to foods. These crops have other uses such as food preservation, medicine, religious rituals, cosmetics, perfumery or used as vegetables. Hence, efforts have been diverted to critically summarize the botanical description & medicinal benefits of different probable seed spices *viz*., Parsley, Black cumin, Black caraway, Indian dill, Sweet fennel, Poppy, Sesame & mustard in this review (Table 1).

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Table 1. Basic information of different minor seed spices.

S.N.	Crops	Scientific name	Family	Origin	Chromosome number (2n)	Other name
1.	Parsley	*Petroselinum crispum*	Apiaceae	Central and eastern Mediterranean	22	Garden parsley
2.	Black Cumin	*Bunium bulbocastanum*	Apiaceae	Western Europe	14	Blackseed, Great pignut
3.	Black Caraway	*Bunium persicum*	Apiaceae	Central Asia and Northern India	14	Kalazeera, Shahijeera
4.	Indian Sowa	*Anethum sowa*	Apiaceae	Mediterranean region of Europe & Africa	20	Indian Dill
5.	Sweet Fennel	*Foeniculum vulgare* Miller ssp. *Capilaceum* var. dulce	Apiaceae	Mediterranean region	22	European fennel
6.	Black Mustard	*Brassica nigra* (2n = 16)	Brassicaceae	Middle East	16	Kali sarson
7.	Indian mustard	*Brassica juncea* (L.) Czern (2n= 36)	Brassicaceae	Russia and Central Asia	36	Brown sarson
8.	White mustard	*Sinapis alba* (2n = 24)	Brassicaceae	Mediterranean region	24	Safed sarson
9.	Poppy seed	*Papaver somniferum*	Papaveraceae	Southeastern Europe and western Asia	22	KhasKhas
10.	Sesame	*Sesamu mindicum*	Pedaliaceae	Asia or East Africa	26	Til/ gingli

1. Parsley(*Petroselinum crispum)*

Garden parsley is a bright green, biennial plant in temperate climates or an annual herb in subtropical and tropical areas. In the temperate region, it produces 10-25 cm long leaflets and a tap root to store the food reserve during the first year of the crop. In the second year, it starts flowering (inflorescence is umbel type where a large number of yellowish to green flowers are produced).

There are three types of parsley cultivated in different parts of the world.

1. **Curly leaf parsley (French parsley; *Petroselinum crispum* var. *crispum*)**: Used for garnish purpose
2. **Flat leaf parsley *(Italian Parsley; Petroselinum crispum* var. *Neapolitanum*)**: Used for garnish purposes but it has a stronger flavor which is due to the presence of high essential oil *apiol*(Herbst 2001). It is closely related to natural wild species and has more tolerance for both rain and sunshine.
3. ***Root parsley (Hamburg parsley*; *Petroselinum crispum* var. *tuberosum*):** Used This type of parsley produce much thicker roots and is very commonly used in Central and Eastern European cuisine.

Parsley is mainly used for culinary purposes, as fresh green leaves, roots for salad/vegetable purposes and seeds are also used in cooking, to impart a stronger parsley flavor than leaves. Parsley is used for its leaf in the same way as coriander (which is also known as Chinese parsley or cilantro), although it has a milder flavor.

Medicinal uses*:* Its essential oil, particularly that from the seed, contains the chemicals *apiole* and *myristicin* and these constituents are diuretic and act as uterine stimulates. An advisory panel on herbal medicines, in German Commission, has approved parsley for use in the prevention and treatment of kidney stones (Hanrahan and Frey 2005). It is also act as emanmenagogue and increase diuresis by inhibiting the

Na+/K+-ATPase pump in the kidney (Kreydiyyeh and Usta 2002). It is also used to reduce the itching in mosquito bites as it inhibits the secretion of histamine (Hanrahan and Frey 2005). Parsley's germination is extremely slow and inconsistent and may require three to six weeks for germination which might be due to the presence of Furanocoumarins in the seed coat. Parsley is the rich source of Vitamin C (133 mg per 100 g & 160% of DV), vitamin K (1640 ug per 100 g & 1562% of DV), Vitamin A, Iron (6.2 mg per 100 g) & Magnesium (50 mg per 100gm) (USDA).

2. Black Cumin (*Bunium bulbocastanum*)

Bunium bulbocastanum, also known as kala jeera (black cumin), is a perennial aromatic spice found in dry temperate regions of northwest Himalayas (Himachal Pradesh, Kashmir, and Uttarakhand) (Kuroishi, 2000). The plant is branched and leaves are 2–3 pinnate and finely dissected. The inflorescence is compound umbels and has white-colored flowers which are hermaphrodites in nature. The small, rounded taproot is edible raw or cooked, and said to taste like sweet chestnuts.

Medicinal uses: Black cumin seeds are an abundant source of antioxidant activity and high phenoliccontent (Center*et al.,* 2012). It also has antimicrobial, antioxidant, anti-inflammatory, antidiabetes, antihyperlipidemic and analgesic properties due to the presence of high oxygenated monoterpenes, especially γ-Terpinene, cumin aldehyde, ρ-cymene and limonene in essential oil (Ernst, 2005).

3. Black Caraway (*Bunium persicum*)

Black Caraway(*Bunium persicum*, 2n = 2X = 14) is an important spice belonging to the family Apiaceae and mostly grows in the wild form in the dry temperate regions of Europe and Central Asia, particularly in the Northern Himalayan region. In India, it is confined to hilly Gurez, Machill, Tangdar, Pulwama,Paddar, Karnah, Karewas of Budgam and Srinagar (Anonymous, 2004). The plant parts of black caraway have typically Apiaceae features viz., 30-80 cm plant height, branched, pinnate leaves, small & white colored flowers consisting of symmetrical sepals & petals, and formed compact umbel inflorescence. The seeds of black caraway are dark brown in nature (Panwar, 2000). *Bunium persicum* is widely used for culinary and medicinal purposes due to its presence of strong earthy aroma (Sharififar*et al*., 2010) and Carminative (Sofi*et al*., 2009), anticonvulsant, anti-diabetic, anti-asthma, antispasmodic,antiepileptic (Miraj and Kiani, 2016) anti-inflammatory activity, anti-oxidative, antimicrobial and antiparasitic properties (Rahimi*et al.,* 2010; Hajhashemi*et al*., 2011; Mandegary*et al*., 2012). The medicinal properties of black cumin are due to the presence of various chemical compounds in its essential oil (4-7%) viz., cuminaldehyde, gamma terpinene, γ-terpinene, α-pinene, β-pinene, myrcene, α-terpinene, α-cymene, ρ-cymene, limongamma-terpineneene, β-sinensal, β-selinene, Germacrene-B, and Dillapiole (Bhat *et al.,* 2017; Sekine*et al.,* 2007).Bunium seeds are mainly used for the preparation of different formulations used for coating/pelleting for different foods to enhance their shelf life (Aminzare*et al.,* 2017). Apart from this, Bunium seeds are used for food preservatives due to its antimicrobial and antioxidant properties (Ehsani*et al.,* 2016).

4. Indian Sowa (*Anethum sowa L.*)

Indian Sowa (*Anethum sowa* L.) is an annual and cold weather seed spice crop belonging to the family Apiaceae. This seed spices crop plant is 2.5-3 ft in height with small feathery leaves producing yellow-colored umbel flowers. Indian sowa seeds have a warm, pungent flavor and a fragrance that resembles caraway. Seeds of Indian dill contain 2.5 - 4% essential oil and some growth inhibitor compounds viz., furanocoumarins and hydroxycoumarins. Due to the presence of growth inhibitors, it is used in potato godowns to inhibit budding process in the Mediterranean region. The major component of the essential oil is carvone, limonene, apiole, dihydrocarvone, carvacrol, and p-cymen. The Indian dill seeds are known to contain more dillapiole (36%) and less carvone (19.5%) as compared to European sowa (7% & 45.9%) respectively whereas, it contains les number of flowers in umbel as compared to European dill (Gupta, 2004). The sowa seeds are have anti-carcinogenic, insecticidal, analgesic, antioxidant, antimicrobial and anti-infertility activities (Mathur, 2012). *Anethum sowa* root is a rich source of mineral constituents along with amino acids. Inorganic elements remain complexed with organic ligands and make them bioavailable to the body system. The roots of Indian sowa contain 81.99% Apiol in essential oil.

5. Sweet fennel/European fennel (*Foeniculum vulgare* Miller ssp. *Capilaceum* vardulce)

Fennel is one of them, generally known as Saunf (*Foeniculum vulgare*) belonging to the Apiacae family. Fennel originates from the Mediterranean region but it

canbe found around the world today. Based on appearance of plant & seed and essential composition, *Foeniculum vulgare* was classified into two major subspecies:

1. **Wild fennel**: *Foeniculum vulgare ssp. Piperitum*
2. **Cultivated fennel**: *Foeniculum vulgare ssp. capillaceum*

Further, based on their uses and fragrance, cultivated fennel (*Foeniculum vulgare ssp.Capillaceum)* was divided into three major varieties

1. **Bitter Fennel***: Foeniculum vulgare var. vulgare*
2. **Sweet Fennel**:*Foeniculum vulgare var. dulce*
3. **Culinary Florence fennel:***Foeniculum vulgare var. azoricum*

The seeds of sweet fennel contain 3.26% essential oil as compared to 1.47% in bitter fennel (Miraldi, 1999). The different taste of sweet and bitter fennel is due to the varying quantities oftrans-anethole and fenchone in the essential oil. Essential oil from sweet fennel fruits includes lower fenchone (0.62%) and higher trans-anethole (95.25%) than bitter fennel fruits (5.03% & 75.13%) respectively (Cosge*et al.,* 2008). Petroselinic acid (C_{18}:1) is a characteristic fatty acid of the family Apiaceae and particularly of fennel oil which have antimicrobial activities and it further synthesize the lauric acid ((C_{12}:0) which highly used in soap, cosmetic, medical and perfume industries (Reiter, *et al.,*1998).

6. Poppy (*Papaver somniferum*)

Poppy seed is the dried seed of *Papaver somniferum*, an erect annual herb, 30-150 cm long with 0.5-1.5 cm thick stem. Stem is glabrous with thick waxy coating (*Raghavan, 2006)*. The seeds come from the poppy plant. Manufacturers use the sap of the poppy plant to make opioid drugs such as heroin, morphine, and oxycodone. This means that poppy seeds can sometimes contain small amounts of opiate compounds. Poppy is cultivated in the temperate and sub-tropical region and requires well drained, highly fertile, light black cotton soil having good percentage of fine sand (*McGee, H. 2004)*. The Papaveraceae consist of annual or perennial herbs, the leaves are spiral to subopposite, the inflorescence is a solitary flower or cyme, the flowers are bisexual, actinomorphic, zygomorphic, or biradial, hypogynous, anthers are tetrasporangiate or bisporangiate and the gynoecium is syn-carpous, with a superior ovary. The fruit is a longitudinally dehiscent or poricidal capsule, sometimes a schizocarp or nut (Yiu H. and Hui. 2006).

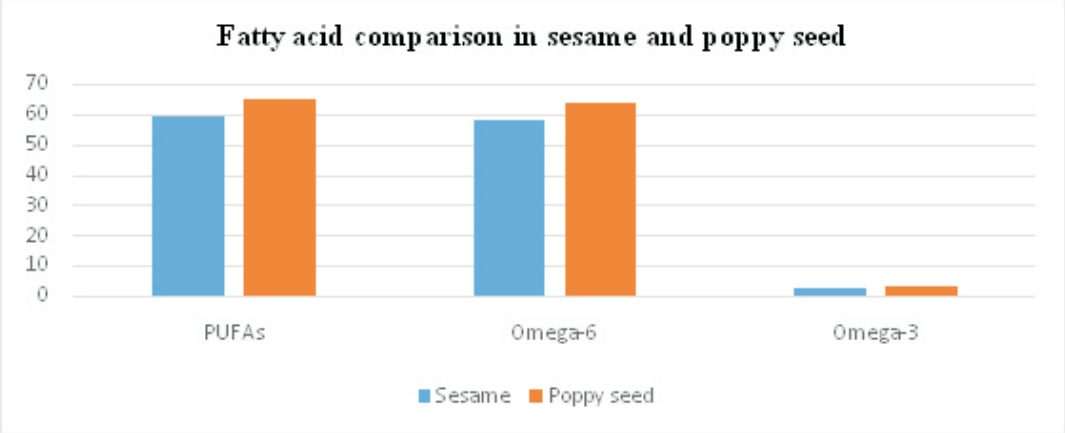

Fig. 1: Fatty acid comparison between in sesame and poppy seed

Nutritional profile:

Poppy seeds contain 40 to 50% of fixed oil, which is obtained by cold pressing in yields of only 12 to 18%. It is rich in unsaturated fatty acids (iodine index is 133 to 144): 60% linoleic acid, 30% oleic acid, 3% linolenic acid (triply unsaturated; essential for human nutrition) and less than 10% saturated fats. Besides wax, resin, proteins and sugars, it contains approximately 20% of alkaloids, of which morphine (morphin, typically, 12%) is the most important. Opium for smoking is roasted over fire and fermented, which reduces the alkaloid content to about one quarter and leads to the development of a typical flavour (*FAOSTAT, 2019; Singhal et al., 1997)*.

Uses:

Poppy seed (KhasKhas) is used as food and as a source of fatty oil. It is widely used for culinary purposes.

Because of its highly nutritive nature it is used in breads, cakes, cookies, pastries, curries, sweets and confectionery. Its seeds are demulcent and are used against constipation. The capsules are used as a sedative against irritant coughing and sleeplessness in the form of syrup or extract (*Ward, 1911)*.

Table 2: Nutritional value of Sesame and Poppy seed

Particulars (per 100g)	Poppy seed	Sesame seeds
Calories	525	573
Carbohydrates	28.13 g	23.45 g
Fat	41.56 g	49.67 g
Dietary fibre	19.5 g	11.8 g
Protein	17.99 g	17.73 g
Calcium	1438 mg	975 mg
Iron	9.76 mg	14.55 mg
Magnesium	347 mg	351 mg
Phosphorus	870 mg	629 mg
Potassium	719 mg	468 mg
Sodium	26 mg	11 mg
Zink	7.9 mg	7.75 mg
Vitamin B1 (Thiamine)	0.854 mg	0.791 mg
Vitamin B2 (riboflavin)	0.1 mg	0.247 mg
Vitamin B3 (Niacin)	0.896 mg	4.515 mg
Vitamin B5	0.324 mg	0.05 mg
VitaminB6	0.247 mg	0.79 mg
Vitamin B9 (Folic acid)	82 mg	97 mg
Vitamin E	1.77 mg	0.25 mg

Source:https://calories-info.com/poppy-seed-vs-sesame/

7. Sesame (*Sesamum indicum* L.**)**

Sesamum indicum L. (syn. *S. orientale* L.) Pediliaceae. Sesame has one of the highest oil contents of any seed, approximately 50 % oil and 25 % protein. The oil can survive for long periods before going rancid due to the presence of antioxidants, sesamol and sesamolin. Sesame is an oilseed crop that is self-pollinating and annual but occasionally perennial. Sesame has zygomorphic flowers with pendulous tubular corolla of 3-4 mm in length and coloring of various shades of purple white (*Bedigian, 2004)*.

Nutritional profile

Seed oil content is 28.9%. The oil contained 10.9% palmitic acid, 45.1% oleic acid, and 36.3% linoleic acid, with traces of linolenic acid. The tocopherol content amounted to 26.4 mg$100g^{-1}$ oil and gamma tocopherol was the predominant tocopherol; it represents about 21.4 mg $100g^{-1}$, followed by α-T and β-T, which represented about 1.9 and 1.4 mg$100g^{-1}$, respectively (Fuller, 2003).*Sesame is rich in calcium (about 1.0%) and phosphorus (about 0.7%). But much of the calcium is contained in the seed coat and is lost if the seed is decorticated (*Fuller and Allaby, 2010).

Uses:

Like many other vegetable oils, sesame is lacking in protean, but it is rich in vitamin. Sesame seed is very nutritious. Sesame oil is esteemed as a food because of its high quality and stability. The anti-oxidant and synergistic properties are provided by sesamoid and sesame contained in the seed. They constituteabout0.3 to 0.5%and 0.5 to 1.0%, respectively (Oplingeret al., 1990).

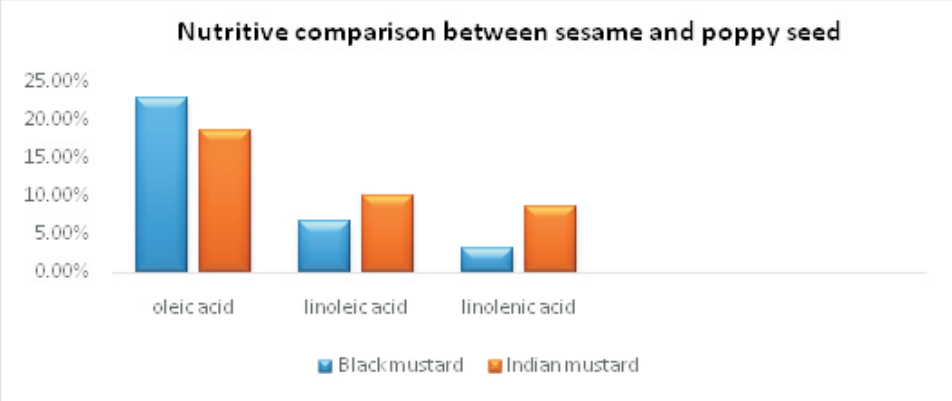

Fig. 2: Nutritive comparison between sesame and poppy seed

8. Mustard

Mustard is a herb belonging to the Brassicaceae family and the dry seeds are the only part used. There are approximately 40 different species of mustard plant. Three different types are generally used to make the mustard condiment. Black mustard (*Brassica nigra* L. Koch) is the most pungent. White mustard (*Brassica/Sinapsis alba* L.) is the most mild and is used to make traditional American yellow mustard. Indian mustard (*Brassica juncea* L.Czernj et Cosson) is dark yellow, has a pungent taste, and is used to make Dijon mustard. It is easier to harvest the brown mustard seed than the black mustard seed, so many mustard condiments now contain brown mustard seed instead of black mustard seed. White mustard has been used effectively for food and medical applications, one of the limiting factors for human use of mustard products is the spicy flavor produced by myrosinase enzyme activities (Ali and McKay, 1982). Indian mustard had higher myrosinase activity (2.75 un/mL) than black (1.50 un/mL) and white mustard (0.63 un/mL) (Ildikó, *et al*., 2006).

Black mustard

Indian mustard

White mustard

Fig. 3: Photographs of different types of mustard

Table 3: Botanical description of different types of mustard

Particulars	Black mustard	Indian mustard	White mustard
Root	Tap root system	Tap root system	Tap root system
Stem	Erect, branched above, glabrous and glaucous above	Erect, branched above,	Erect, ascending, leafy, simple or branched distally
Leaf	Simple, alternate	Simple, alternate	Obovate-oblanceolate to oblong
Inflorescence	Panicle	Panicle	Raceme corymbs
Flower	Complete, pedicillate	Complete, pedicillate, hermaphrodite, cruciform	Divaricate, slender, ascending
Calyx	Sepal oblong or spreading	Sepal oblong	Sepals 4, erect or spreading, linear oblong
Corolla	Petal 4, cruciform	Petal 4, cruciform, yellow in color	Petal 4, obovate-oblanceolate
Androecium	Stamen 6, tetradynamous	Stamen 6, tetradynamous	Stamen 6, tetradynamous,
Gynoecium	Ovary cylindrical, superior	Ovary cylindrical, superior	Superior, bicarpellary
Fruit	Siliqua	Yellow brown siliqua	Siliqua, dehiscent,

1. *Brassica nigra,* known as black mustard, is grown in Argentina, Chile, the U.S., and some European countries. It is a tall plant, up to three meters, and sparsely branched (Downey 2003). Black Mustard is a winter annual crop in the Mustard family. *Brassica nigra* is cross-fertilizing. Pollination is by insects, for example various bee species and pollen beetles such as Meligethesspp (Baldwin *et al.*, 2012**)**.

Nutritional profile

The glucosinolate of *Brassica nigra*, called sinigrin, releases the aggressive, volatile allyl isothiocyanate which is responsible for the pungent taste of black mustard; it is also a strong irritant of the mucous membranes and skin, and is used in dog and cat repellents (Bell and Muller, 1973**)**. Black mustard contains about 1% sinigrin (allylglucosinolate), a thioglycoside-like compound (also-called glucosinolate) of ally iso-thiocyanate with glucose. By action of the enzyme myrosinase, allyl iso-thiocyanate, a pungent, lachrymatory and volatile compound, is liberated (0.7% of the dried seed) (DiTomaso and Healy, 2007**)**.

Note that iso-thiocyanates are aggressive substances that have the function of a chemical weapon against herbivorous animals. Besides glycerides of linoleic and linolenic acid, mustard oil contains glycerides of erucic acid, which is considered harmful to human health; furthermore, traces of free isothiocyanates may be found in mustard oil (Burkill, 1966**)**. Therefore, despite its high fraction of unsaturated fatty acids (iodine index is 105), mustard oil cannot be recommended without qualification for cooking purposes.

Uses:

In the UK, the plant was used to make "hot mustard baths", which would aid people with colds. Ground seeds of the plant mixed with honey are widely used in eastern Europe as cough suppressant. In Eastern Canada, the use of *mouche de moutarde* to treat respiratory infections was popular before the advent of modern medicine. It consisted in mixing ground mustard seeds with flour and water, and creating a cataplasm with the paste. Mustard poultice could also be used to aid muscular pains (Cal-IPC, 2004**)**.Black mustard might lower blood sugar levels when taken as a medicine. If you have diabetes and take medications to lower your blood

Table 4: Nutritional value of different type of mustard

Nutritional parameters	Quantity		
	Black Mustard	**Indian mustard**	**White mustard**
Vitamin K	-	829.8 µg	-
Vitamin A	-	865 µg	-
Vitamin C	39.33 mg	35.4 mg	-
Selenium (Se)	-	0.8 mg	0.9 mg
Copper (Cu)	0.151 mg	0.204 mg	0.28 mg
Vitamin E	1.94 mg	2.49 mg	-
Calcium, (Ca)	60 mg	165 mg	105 mg
Iron (Fe)	1 mg	1.22 mg	1.55 mg
Betaine	-	0.3 µg	-
Vitamin B6	-	0.137 mg	-
Zinc (Zn)	0.31 mg	0.22 mg	0.27 mg
Magnesium (Mg)	15 mg	13 mg	17 mg
Phosphorus (P)	47 mg	42 mg	36 mg
Folate	-	9 ?g	-
Potassium	81 mg	-	94 mg
Sodium	5 mg	-	11 mg
Fiber	2 g	1.8 g	-
Protein	3 g	3.1 g	2.9 mg
Fat	3.5 g	-	-

Source: *https://www.healthbenefitstimes.com/mustard-greens-brassica-juncea-facts/*

sugar, adding black mustard might make your blood sugar drop too low. Monitor your blood sugar carefully (Center for New Crops & Plant Products, 2013**)**.

2. Indian mustard (*Brassica juncea***)**

Brassica juncea, known as brown or Indian (Oriental) mustard, is originally from the foothills of the Himalaya. The species is believed to have originated as a natural cross between *Brassica rapa* (turnip rape) and *Brassica nigra*, followed by chromosome doubling to form a vigorous hybrid (Downey 2003). The outcrossing varied from 7.6 to 18.1 per cent (Herbst, 2001).

Nutritional profile

Indian mustard has different nutritional content as shown in Table 4. In a 100-gram, cooked mustard greens provide 110 kilojoules (26 kilocalories) of food energy and are a rich source (20% or more of the Daily Value) of vitamins A, C, and K—K being especially high as a multiple of its Daily Value (McNulty, 2002).

Uses:

The mustard seeds were crushed into anointment and applied to cure sore muscles. The first century Roman writer Pliny the Elder noted that mustard was very useful as a medicine to cure “epilepsy, lethargy, and all deep seated pains in any part of body (SMDC, 2008). By the time of the middle Ages, mustard's medicinal properties were secondary to its use as a food-enhancer and spice, however, it was also still being used for some medical issues including a treatment for gout, sciatica, and as a blood thinner (Trowbridge, 2008). At this time, mustard was also being utilized for psychological, or social reasons, as an “effective cure for hysterical women. As the plant spread, it became a very significant medicinal plant for Native American medicinal uses when it reached North America. Mustard, particularly white mustard was noted to be an “excellent household remedy”, when ingested in large quantities it could be used to induce vomiting in the case of poisoning, yet at the same time was recommended as a daily remedy for bowel troubles (Zohary and Hopf, 2000).

3. White mustard (*Sinapishirta*):

Sinapis*hirta* (or *S. alba*), known as white or yellow mustard, grows wild in North Africa, the Middle East, and Mediterranean Europe and has spread farther by long

cultivation. *S. hirta* plants are shorter (0.6 meters) than the other two species, have leaves that are deeply lobbed, and the short, hairy pods have five to six seeds, which they also retain when ripe (Downey 2003). While seeds of *B. nigra* and *B. juncea* are considered to have the same pungency, seeds of white mustard are considered to be different in pungency.White mustard seeds are mostly used for the preparation of mustard pastes, for which purpose they are superior to black mustard, because their pungent principle (p-hydroxy benzyl isothiocyanate) is non-volatile and stable to hydrolysis in acidic environment. The seeds contain sinalbin, which is a thioglycoside responsible for their pungent taste. White mustard has fewer volatile oils and the flavor is considered to be milder than that produced by black mustard seeds (Webb *et al.*, 1996).

Nutritional profile:

Besides proteins (28%) and fixed oil (35%), white mustard seeds contain approx. 2.5% sinalbin, a thioglycoside-like compound of glucose and p-hydroxybenzylisothiocyanate ($HO–C_6H_4–CH_2–NCS$). (Beesley and Wilde, 1997). White mustard essential oil (WMEO), an essential oil of low volatility, is new and not available commercially at this time; however, it is a sustainable and underutilized by-product of considerable value for the mustard industry (Tan, 2011). Mustard seeds are an excellent source of selenium and a very good source of omega-3 fatty acids and manganese. They are also a good source of phosphorus, magnesium, copper and vitamin B1 (*Balke, 2000)*.

Uses:

People take white mustard for “clearing the voice,” preventing infection, causing vomiting, increasing urine flow (as a diuretic) to relieve water retention, and increasing the appetite (Beesley and Wilde, 1997). Some people apply white mustard directly to the affected area for cough and colds, chest congestion, bronchitis, swollen joints, arthritis-like pain (rheumatism), osteoarthritis, back pain (lumbago), and sore mouth and throat. It is sometimes used in a bath to treat paralysis (*Balke, 2000)*.In foods, white mustard is one of three types of mustard typically used to make mustard condiment. Black mustard (*Brassica nigra*) is the most pungent. White mustard (*Brassica alba*) is the most mild and is used to make traditional American yellow mustard. Brown mustard (*Brassica juncea*) is dark yellow, has a pungent taste, and is used to make Dijon mustard. It is easier to harvest the brown mustard seed than the black mustard seed, so many mustard condiments now contain brown mustard seed instead of black mustard seed.

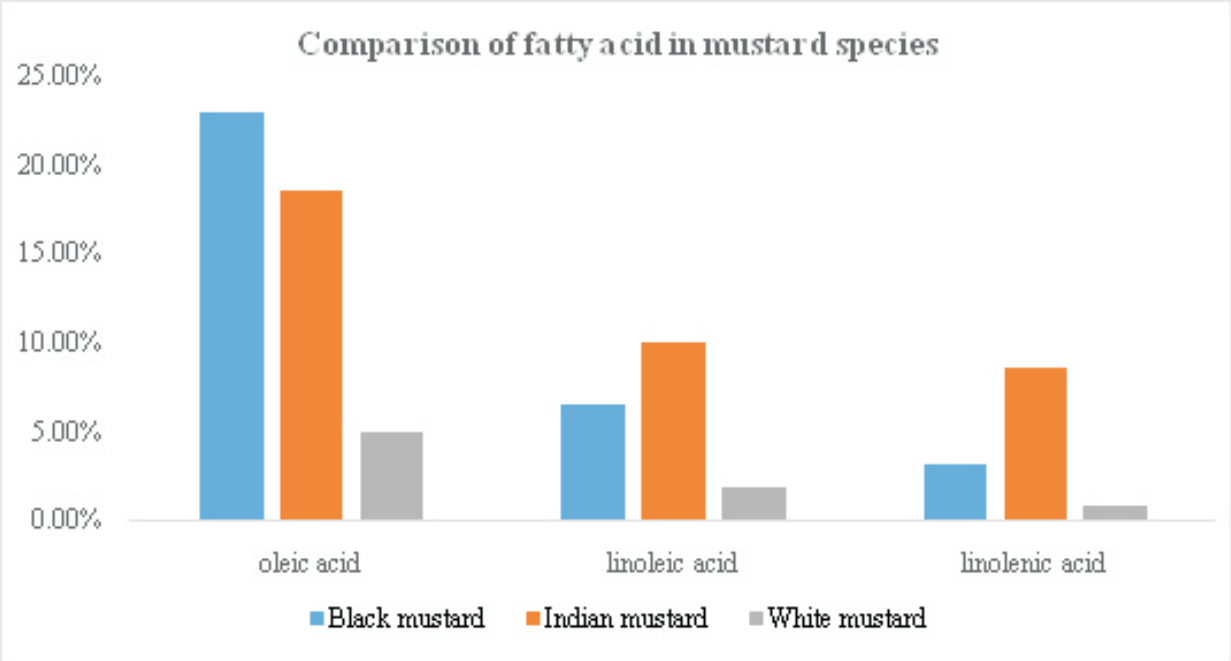

Fig. 4: Comparison of fatty acid in mustard species

Conclusion:

This is to summarized that mentioned minor seed spices have immense potential with respect to nutrition, medicinal properties, therapeutically and culinary purposes. The future research & development endeavor in these crops will have vital opportunities to find out more potential for wellbeing of human kind.

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