

Potential health benefits of major seed spices

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Abstract

The seed spices constitute an important group of agricultural commodities and play a significant role in our national economy. Historically, India has always been recognized as a land of spices. The crops covered as major seed spices are coriander, cumin, and fennel are the member of umbelliferae and fenugreek is belongs to family Fabaceae. These spices are collections of a wide variety of volatile and non-volatile staple dietary additives. These spices have been known for ages as effective therapeutic food. The power of seed spices to impart biological activity is now slowly re-emerging as an area of interest for human health. Seed spices produce numerous secondary metabolites or phytochemicals, these are naturally occurring, biologically active chemical compounds in plants, where they act as a natural defence system for host plants and that have historically been used as pharmaceuticals, fragrances and flavor compounds. They are a gold mine of possibilities in our search for beneficial bioactive compounds for pharmacology and other health related issues. Seed spices influence various systems in the body such as gastrointestinal, cardiovascular, and reproductive and nervous systems resulting in diverse metabolic and physiologic actions. Seed spices have a diverse array of natural phytochemicals that have complementary and overlapping actions, including antioxidant effects, Anticancer, Antidiabetic, Antimicrobial Activity, Hypolipidemic effect, Insecticidal, useful in menstrual disorders, helping in digestion, Hypertension, Modulation of detoxification enzymes, stimulation of immune system, reduction of inflammation, modulation of steroid metabolism and helps in improve other several human disorder. The present review is an effort to present a consolidated report on the current status of research related potential human health benefits of four major seed spices namely Cumin, Coriander, Fennel and Fenugreek.

Key words : Seed spices, cumin, coriander, fennel, fenugreek, nutraceuticals, antioxidant.

Introduction

Spices have been known for ages as effective therapeutic food. The power of spices to impart biological activity is now slowly reemerging as an area of interest for human health. The seed spices constitute an important group of agricultural commodities and play a significant role in our national economy. Historically, India has been recognized as a land of spices. The states, Rajasthan and Gujarat have together contributed more than 80 per cent of the total seed spices produced in the country. The crops covered as major seed spices are coriander, cumin, fennel and fenugreek, whereas ajowan, dill (sowa), celery, nigella (kalonji), caraway (siah jeera) and anise constitute minor group of seed spices.

Seed spices produce numerous secondary metabolites or phytochemicals, these are naturally occurring, biologically active chemical compounds in plants, where they act as a natural defense system for host plants and that have historically been used as pharmaceuticals, fragrances, flavor compounds, dyes, and agrochemicals. With the help of modern biological and computational science technology chemoinformatics will help us to

development of novel drugs. Even today, these metabolites are a major source of new drugs (Rathore *et al.*, 57). They are a gold mine of possibilities in our search for beneficial bioactive compounds for pharmacology and other health related issues. The present export of herbal raw materials and medicines from India is about US\$ 110-114 million per year. Chemoinformatics opens a new ways to explore seed spices as gold mines for farmaceuticals industries (Rathore *et al.*, 55). They are classified by functional groups, e.g. alcohols, aldehydes, amines, esters, ethers, ketones, terpenes, thiols and other miscellaneous compounds. In spices, the volatile oils constitute these components (Zachariah *et al.*, 78).

Population demographics, increased focus on health versus disease, drive towards self care and self diagnosis and growing knowledge of consumers about traditional medicines are the main driving force for the growth of global phytochemical industry. Today, these metabolites are a major source of new drugs. Plant-derived substances have recently become of great interest owing to their versatile applications. The present review is an effort to present a consolidated report on the current status of research related potential human health benefits of four

major seed spices namely Cumin (*Cuminum cyminum* L.), Coriander (*Coriandrum sativum* L.), Fennel (*Foeniculum vulgare* Mill.) and Fenugreek (*Trigonella foenum-graecum* L.).

Cumin (*Cuminum cyminum* L.):

Cumin is a seed spice belonging to the family umbelliferae. Cumin and value added products from cumin are used in food flavoring and perfumery. Cumin contains volatile oil (3–4%), the major active principle of volatile oil is cuminaldehyde, which is present to an extent of 45–50% and is an important phytochemical and possesses many health benefits. Shaath and Azzo (67), reported that the main constituents of cumin seed oil were cuminaldehyde which is responsible for its characteristic odour other components are α -pinene, α -terpinene, *p*-mentha-1,3-dien-7-al, *p*-mentha-1,4-dien-7-al, and *p*-cymene. Borges and Pino (13). Cumin seed contains moisture (7%), volatile oil (3–4%), protein (12%), total ash (10%), fiber (11%), carbohydrate (33%), starch (11%), and fat (15%). The composition of cumin changes according to the region and climate where it is grown.

The seeds are used in cooking and the volatile oil is used for food flavoring and in cosmetics and perfumery industries. Cumin and cumin oil are used to flavor soups, meats, cheese, pickles, and bread. The oil is used as a fragrant component of creams, lotions, and perfumes as well as to standardize the volatile oil content of oleoresin in the food processing industries. Cumin also has a number of medicinal uses and helps in curing many diseases. Cumin seeds are a very good source of iron. In Ayurvedic medicine, cumin is considered a warming spice, invaluable for digestion. It is also a cleansing spice that helps burn toxins and enhances the appetite. Traditional uses of cumin include anti-inflammatory, diuretic, carminative, and antispasmodic. It has also been used to treat dyspepsia, jaundice, diarrhea, flatulence, and indigestion. Cumin powder is used as a poultice and smoked in a pipe and also taken orally.

Medicinal and Pharmacological Properties

Antioxidant Activity: Cumin seeds contain flavonoids, viz., apigenin and luteolin, which are now generally recognized to have antioxidant activity. The petroleum ether soluble fraction of cumin has been reported to have antioxidant activity (Leung 36). Cuminaldehyde has been demonstrated to scavenge the superoxide anion (Krishnakantha and Lokesh 31).

Anticancer Effects: The spice appears to have an anticancer effect as demonstrated by the ability of cumin seeds to inhibit the induction of gastric squamous cell carcinomas (Gagandeep *et al.*, 23). In rats fed with cumin,

a protective effect against induced colonic cancer was demonstrated.

Antidiabetic: Dietary cumin countered other metabolic alterations as revealed by lowered blood urea level and reduced excretions of urea and creatinine by diabetic animals (Willatgamuwa *et al.*, 76). The elevated plasma urea level of diabetic animals was significantly lowered by about 50% by dietary cumin. Cumin has been used as one of the ingredients of a herbal antidiabetic drug, which was found to be effective in human subjects (Karnick 28).

Antimicrobial Activity: Essential oil and alcoholic extract of cumin has shown antimicrobial activity against *Klebsiella pneumoniae* ATCC 13883 and ceftazidime-resistant strain. Cumin oil and cuminaldehyde have been reported to exhibit strong larvicidal and antibacterial activity. The essential oil and alcoholic extract of cumin seed could be used in medicinal industries (disinfectant or antiseptic) (Derakhshan *et al.*, 17).

Blood Platelet Aggregation: Cumin extract in ether inhibited arachidonate-induced platelet aggregation in human platelets in a dose-dependent manner (Srivastava 71).

Dietary Fiber: Soluble and insoluble dietary fibers, considered as important elements in human diet, are the storage of cell wall polysaccharides of plants that cannot be hydrolyzed by human digestive enzymes. Cumin is reported to contain 15–45% crude fiber and except for a few, very little information is available on dietary fiber content in spices. Cumin spent is obtained out of which a major portion uses as boiler feed and only a small quantity is consumed in the veterinary feed formulations. The cumin spent which does not have any commercial value has been evaluated as a new source of dietary fiber for its quality, physicochemical characteristics, and application potential.

Coriander (*Coriandrum sativum* L.):

Coriander (*Coriandrum sativum* L.), a medicinal and culinary plant from the umbelliferae family, is one of the important spice crops. A native of eastern Mediterranean region, coriander is now widely cultivated in many other parts of the world for its leaves, seeds and essential oil production. It is commonly grown in India, Pakistan, Bangladesh, Russia, Central Europe, Morocco, and China. India is the world's largest coriander producer, where the seeds and leaves of this spice are widely used for various food applications and essential oil extraction.

The volatile oil content of the spice can vary considerably according to the type and source and usually ranges from

0.1 to 1.7% and, in some cases, up to 2.7%. European coriander is mainly of the small fruited type and usually has volatile oil content greater than 0.4%, with the highest values exhibited by some Russian cultivars. The composition of the volatile oil, which determines the odour and flavour character, contains both volatile and fixed oil. The volatile oil is rich in beneficial phytonutrients, including carvone, geraniol, limonene, borneol, camphor, elemol, and linalool. Linalool is the major constituent (25-80 per cent) (Purseglove *et al.*, 52).

Coriander seeds have a health-supporting reputation that is high on the list of the healing spices. In parts of Europe, coriander has traditionally been referred to as an anti-diabetic plant. In some parts of India, it has traditionally been used for its anti-inflammatory properties.

Medicinal and Pharmacological Properties

Antioxidant activity: Leaf and seed extracts of coriander and coriander oil were tested for their antioxidant activity using different bioassay techniques and a positive correlation were found between total phenolic content in the extracts and antioxidant activity. Coriander leaves showed stronger antioxidant activity than the seeds. A marked reduction in the induced free radical levels in the liver of pre fed rats with coriander seed powder. In a study cryogenic grinding technology is helpful in retention of flavour and medicinal properties of coriander irrespective of genotypes from diverse origin showed significantly increase in oleoresin content, total phenolic contents, flavonoids and antioxidant properties (Rathore, *et al.*, 58; Saxena *et al.*, 61; Saxena *et al.*, 64).

Hypoglycemic activity: Coriander has been documented as a traditional treatment for diabetes from immortal time. Coriander lowered the blood sugar when added to the diet of diabetic mice. The antihyperglycemic action of coriander is associated with stimulation of insulin secretion and enhancement of glucose uptake and metabolism by muscle, reflecting the effects of more than one active constituent. Coriander therefore, represents a possible antihyperglycemic dietary adjunct and potential source of orally active agent(s) for diabetes therapy. The presences of antihyperglycaemic, insulin releasing and insulin-like activity in coriander were demonstrated by Selvan (66).

Hypolipidemic activity: The study shows that the concentrations of cholesterol and cholesterol to phospholipid ratio decreased while the level of phospholipid increased. Coriander plays a protective role against the deleterious effects in lipid metabolism in experimental colon cancer (Nalini *et al.*, 41). Some of the acids present in coriander viz. linoleic acid, oleic acid, palmitic acid, stearic acid and ascorbic acid (vitamin-C) are very effective

in reducing the cholesterol level in the blood. They also reduce the cholesterol deposition along the inner walls of the arteries and veins Ertas *et al.*, (21).

Insecticidal effect: Cumin seed essential oil is effective against stored-product beetle pests. Coriander oil (10 µl) showed insecticidal activity against the bruchid *Callosobruchus maculatus*, the cereal storage pest (Pascual 49).

Aflatoxin control: The essential oil of coriander showed significant inhibitory effects of on the mycelial growth and toxin produced by *A. ochraceus* (Basilico and Basilico 11). the potential of coriander oil in the control of *A. niger*, *Saccharomyces cerevisiae*, *Mycoderma* sp., *L. acidophilus* and *Bacillus cereus* (Meena and Sethi 38).

Antibacterial activity: Essential oils from commercial samples of coriander were showed antibacterial, antifungal and antioxidant activities. The essential oils of coriander showed a high degree of inhibition against twenty-five genera of bacteria and one fungal species (*Aspergillus niger*) (Baratta *et al.*, 10).

Swellings: Cineole is a component of volatile oil and linoleic acid is component of fixed oil of coriander possess antirheumatic and antiarthritic properties and are very beneficial to treat swelling caused due to malfunctioning of kidney or anemia as some of the components help excretion of extra water from the body.

Digestion and control of diarrhea: Coriander, due to its rich aroma because of its essential oils, apart from being an excellent appetizer, helps in proper secretion of enzymes and digestive juices in the stomach, stimulates digestion and peristaltic motion. It is helpful in treating problems like anorexia. Some of the components of essential oils in coriander such as borneol and linalool, aid digestion, proper functioning of liver and bonding of bowels and help to cure diarrhea. It is also helpful to treat diarrhea caused by microbial and fungal action, since components like cineole, borneol, limonene, alpha-pinene and betaphelandrene have anti-bacterial effects. In addition, the fresh coriander leaves are excellent appetizers.

Mouth ulcers: Citronelol, a component of essential oils in coriander, is an excellent antiseptic. In addition, other components have antimicrobial and healing effects which do not let wounds and ulcers in the mouth go worse. They aid healing up of ulcers and freshen up the breath.

Small pox: The essential oils in coriander are rich in antimicrobial, antioxidant, anti-infectious and detoxifying components and acids. The presence of vitamin-C and iron strengthens the immune system too. These properties help, prevent and cure small pox. They also

reduce the pain and have a soothing effect on pox patients.

Menstrual disorders: Being stimulating in nature and helping proper secretion from the endocrine glands, it also helps proper secretion of the hormones and thereby inducing proper menstrual cycles and reducing pains etc. during periods.

Eye care: Coriander has lots of antioxidants, vitamin- A, C and minerals like phosphorus in the essential oils which prevent aging of eye, macular degeneration and soothes eyes against stress. Coriander is a very good disinfectant and has antimicrobial properties which protect the eyes from contagious diseases like conjunctivitis.

Skin disorders: The disinfectant, detoxifying, antiseptic, antifungal and antioxidant properties of coriander are ideal for curing skin disorders such as eczema, dryness and fungal infections. Coriander helps to cure ulcer, inflammation, spasm and acts as an expectorant, protects and soothes liver.

It is anti-carcinogenic, anti-convulsant, anti-histaminic and hypnotic. Coriander is believed to be a natural aphrodisiac and previously it was extensively used in certain preparations, combined with other herbs (Kumar *et al.*, 33). Coriander is good in iron content which directly helps curing anemia.

Fennel (*Foeniculum vulgare* Mill.):

Foeniculum vulgare Mill. (Apiaceae family) commonly known as fennel, is one of the widespread annual or perennial plants with aromatic odor. It was native to Southern Europe and Mediterranean region. Now it is widely cultivated throughout the temperate and tropical

Regions of the world. It is also a very popular medicinal and economic plant in Asian countries. The herb has many culinary and traditional medicine uses. The bulb, young shoots, leaves and fully ripened and dried fruits are commonly used for homemade remedies. Its aromatic fruits have been used as a culinary spice in many countries (Tanira *et al.*, 74). Fennel herbal tea is a common household remedy traditionally used for the treatment of a variety of symptoms of the gastrointestinal and respiratory tract (Raffo *et al.*, 53).

The chemical constituents from the fennel include essential oil, fatty acid, phenylpropanoids, monoterpenoids, sesquiterpenes, coumarins. It also contains triterpenoids, tannins, flavonoids, cardiac glycosides, saponins, and other types of compounds. The relative content of essential oil in fennel fruits was about 3.0 to 5.0 % by weight. The essential oil of the most important fennel variety (var. dulce) contains anethol (50-80%), limonene (5%), fenchone (5%), estragol (methyl-chavicol), safrol, alpha-pinene (0.5%), alpha-phellandrine, camphene, beta-pinene, beta-

myrcene and p-cymen. In contrast, the uncultivated form (var. vulgare) contains often more essential oil, but since it is characterized by the bitter fenchone (12 to 22%), it is of little value. (Piccaglia and Marotti 50). The essential oil of fennel fruits is used for flavouring purpose, cosmetic and pharmaceutical products (Bilia *et al.*, 12). Napoli *et al.* (42), identified 78 compounds from fennel fruits by GC-FID-MS, representing more than 98% of the oils.

The fruits of fennel contain about 20% fatty acids and petroselinic acid is a characteristic fatty acid of fennel oil. The level of petroselinic acid could be as high as 70 to 80% (Reiter *et al.*, 59). The chemical analysis of the acetone extract of fennel showed that linoleic acid (54.9%), palmitic acid (5.4%) and oleic acid (5.4%) were major components in acetone extract (Singh *et al.*, 70).

There has been a growing interest in phenolic components of fruits and vegetables, which may promote human health or lowering the risk of disease. Aqueous extract of fennel fruits contains rich phenolic compounds. Many of them have antioxidant activities, such as 3-caffeoylquinic acid, 4-caffeoylquinic acid, rosmarinic acid, eriodictyol-7-orutinoside, quercetin-3-o-galactoside, kaempferol-3-orutinoside and kaempferol-3-o-glucoside. Besides, these compounds, fennel was reported containing hydroxycinnamic acid derivatives, flavonoid glycosides and flavonoid aglycones (Parejo *et al.*, 47).

Flavonoids were generally considered as an important category of antioxidants in the human diet. Flavonoids were rich in the plants of Apiaceae family. Some flavonoids such as quercetin arabinoside were identified from *F. vulgare* (Harborne *et al.* 26). Flavonoids such as quercetin, rutin and isoquercitrin were reported to have the immunomodulatory activities. In addition, fennel provided an excellent source of potassium, calcium, magnesium, iron, phosphorous and zinc (Trichopoulou *et al.*, 75).

Fennel has many biological activities due to its volatile and nonvolatile compounds. It is prescribed as an aromatic stomachic and treats various conditions, particularly rheumatism, cold pain and stomach. Fennel essential oil possessed carminative and stimulant activities as well as spasmolytic actions on the smooth muscles of experimental animals (Khan and abourashed 30). Furthermore, it possessed analgesic, anti-inflammatory and antioxidant activities. Oral administration of methanol extract of fennel exhibited inhibitory effect against acute and subacute inflammatory diseases and showed a central analgesic effect by inhibition of the allergic reactions. It significantly decreased the high density lipoprotein-cholesterol level, thus decreasing the peroxidative damage (Choi and Hwang 15). The essential oil of fennel exhibited

antibacterial and antiviral activities (Ruberto *et al.*, 62). The aqueous and ethanol extracts of fennel exhibited potential antioxidant properties in vitro studies (Oktay *et al.*, 43). It might be useful for the treatment of cognitive disorders such as dementia and Alzheimer's disease (Joshi 27).

Medicinal and Pharmacological Properties

Antioxidant activities: Now a day's naturally-occurring antioxidants are popular to use to protect human beings from oxidative stress damage. Fennel was known as excellent sources of nature antioxidants and contributed to the daily antioxidant diet (Shahat *et al.*, 68). Wild fennel was found to exhibit a radical scavenging activity with higher content phenolic and flavonoid than medicinal and edible fennel, and the aerial parts of the Italian populations showed the highest DPPH scavenging activity (Faudale *et al.*, 22). The volatile oil showed strong antioxidant activity in comparison with butyrate hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) (Singh 70). Rathore *et al.* (57) concluded that fennel genotype RF-101 show higher TPC, TFC and antioxidant activity in methanolic extract of oleoresin in comparison volatile oil of fennel seeds.

Acaricidal activity: Fennel oil show significant acaricidal activity against *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus*. The major bioactive component is fenchone. *p*-anisaldehyde was the most toxic compound to *D. Farina*. Carvone characterized as bioactive constituent to potential house dust mite *Tyrophagus putrescentiae*. (Lee 35)

Insecticidal activity: The fennel extracts was reported to have insecticidal activity against different mites and insects (Mimica-Dukiæ *et al.*, 39). *Trans*-anethole was known to have effective larvicidal activity against mosquito species (Conti *et al.*, 16). Extracts of fennel were toxic against *Culex pipiens* larvae, and terpineol and 1,8-cineole were the most effective components against *Anopheles dirus* and *Aedes aegypti*, which suggested fennel was an alternative use of synthetic insecticides (Lee 35).

Antimicrobial, antibacterial and antifungal activities: The antimicrobial activity of plant oils and extracts has been recognized for many years, and they have many applications, including raw and processed food preservation, pharmaceuticals, alternative medicine and natural therapies. The chloroform soluble fraction from the stems of fennel exhibited a potent antimicrobial activity against bacteria and fungi. Dillapional, scopoletin, dillapiol, bergapten, imperatorin, psolaren and dillapional were found to be antimicrobial principles against *Bacillus subtilis*, *Aspergillus niger* and *Cladosporium cladosporioides* (Kwon *et al.*, 34). Essential oils from the

fruits of fennel showed significant antibacterial activity to *Escherichia coli* and *Bacillus megaterium* (Araque *et al.*, 7). Fennel essential oils may be useful natural bactericides for the control of bacterial diseases of plants. Essential oils components viz., anethole, fenchone and camphor showed antifungal activities against *C. cladosporioides*, *Penicillium helianthi* and *Trichophyton mentagrophytes*, compared with a standard mycotoxic bifonazol, *Penicillium ochrochloron*, *Penicillium funiculosum* and *Trichoderma viride* were the most resistant species (Mimica-Duki *et al.*, 39; Singh *et al.*, 70).

Dichloromethane extracts and essential oils from *F. vulgare* showed antifungal activity against *Candida albicans*. It could be the candidate for a new antifungal agent for candidiasis and other fungal diseases (Park *et al.*, 48).

Hepatoprotective activity: Fennel essential oil could inhibit the CCl₄ induced acute hepatotoxicity. D-limonene and β -myrcene of the oil might be the potential candidates (Ozbek *et al.*, 44).

Estrogenic activity: Fennel oil was reported to exhibit estrogenic activity, promote menstruation, alleviate the symptoms of female climacteric, and increase libido (Albert-Puleo 3).

Fenugreek (*Trigonella foenum graecum* L):

Fenugreek (*Trigonella foenum graecum* L) is an annual leguminous herb that belongs to the family Fabaceae. It is grown extensively which is native to many Asian, Middle Eastern and European countries. It has a long history as both a culinary and medicinal herb. The seeds of fenugreek are commonly used as a spice in food preparations due to the strong flavour and aroma.

Fenugreek seed contains 45-60% carbohydrates, mainly mucilaginous fiber (galactomannan); 20-30% proteins high in lysine and tryptophan; 5-10% fixed oils (lipids); pyridinetype alkaloids, mainly trigonelline (0.2-0.36%) choline (0.5%), gentianine and carpaine; flavonoids, such as apigenin, luteolin, orientin, quercetin, vitexin and isovitexin; free amino acids, such as 4-hydroxyisoleucine; arginine, histidine and lysine; calcium and iron; saponins (0.6-1.7%); cholesterol and sitosterol; vitamins A, B₁, C and nicotinic acid; and 0.015% volatile oils (nalkanes and sesquiterpenes) (Krishnaswamy 32).

Trigonelline degraded to nicotinic acid and related pyridines during roasting is responsible for the flavor of the seed (Ashihara 8). The importance of diosgenin in the synthesis of oral contraceptives and sex hormones have been documented (Chapagain and Wiesman 5). Numerous studies have been carried out to reveal the therapeutic potential of fenugreek in various pathological

conditions such as diabetes mellitus, cancer, hypertension, cataract, gastric disorders and obesity (Balaraman *et al.*, 9; Mitra and Bhattacharya, 40; Sebastiana and Thampanb 65; Al-dalain *et al.*, 4; Mathern *et al.*, 37; Gupta *et al.*, 25). In a study Rathore *et al.*, (56), found that methyl fatty acid esters shows significant variation among genotypes and grinding methods.

Medicinal and Pharmacological Properties

Diabetes Mellitus: The fenugreek alkaloidal extract prevents the increased blood glucose level, reduced lipid profile to almost normal and showed antioxidant effect on the tissues of liver and kidney in experimental rats (El-Soud *et al.*, 20). Further, fenugreek powder treatment in patients suffering from mild Non-insulin dependent diabetes mellitus produced marked reduction in blood sugar and serum triglycerides and total cholesterol (Mitra and Bhattacharya 40). It has been documented from various studies that saponins and diosgenin present in fenugreek are responsible for hypolipidemic and anti-diabetic action on hypercholesterolaemic rats (Stark and Madar 72).

It has been observed that supplementation of diet with fenugreek leaves and seeds in hyperglycemic rats prevented the increased levels of glucose by stimulating the process of glycolysis and inhibiting gluconeogenesis via stimulating enzymes such as hexokinase and inhibiting enzymes such as glucose 6-phosphatase and fructose 1, 6-biphosphatase and subsequently increasing the secretion of insulin (Devi *et al.*, 18). It has been reported that the active principle present in water extract of fenugreek seeds in subdiabetic and overtly diabetic rabbits stimulated insulin synthesis and secretion from the beta pancreatic cells of langerhans and increased the sensitivity of tissues to available insulin (Puri *et al.*, 51). The soluble dietary fibre fraction known as galactomannan present in endosperm of fenugreek seeds, has shown to reduce postprandial elevation in blood glucose level of Type 2 model diabetic rats by delaying the digestion of sucrose.

Cancer: The effect of fenugreek seeds observed in induced breast cancer in rats (Amin *et al.*, 5), Further, the ethanolic extract of fenugreek showed antineoplastic effect on the growth of breast cancer cells by reducing cell viability, inducing early apoptotic changes, declining the mitochondrial membrane potential and degrading cellular DNA into fragments (Sebastiana and Thampanb 65). Moreover, an *in vitro* study revealed that diosgenin inhibited cell growth and induced apoptosis in the human colon cancer cell (Raju *et al.*, 54). Further, reducing the levels of cholesterol and decreasing the expression of phospholipase A and C are responsible for prevention of tumor formation and improving the histological features. Its estrogenic property can be employed as anticancer

and in hormone replacement therapy in which further studies are warranted.

Antioxidant: It has been documented in various studies that fenugreek bears potential of a powerful antioxidant in which the presences of flavonoids and polyphenols have been found to be responsible for the same (Dixit *et al.*, 19). The exposure of polyphenol rich extract of fenugreek seeds which showed protective effects against hydrogen peroxide induced oxidation by protecting the erythrocytes from haemolysis and lipid peroxidation in a dose dependent manner (Kaviarasan *et al.*, 29). Further, fenugreek administration to diabetic animals showed a reversal of the disturbed antioxidant levels of enzymes such as catalase, superoxide dismutase and glutathione peroxidase and peroxidative damage in the tissues of heart and kidney (Genet *et al.*, 24). Supplementation of fenugreek seed powder to diabetic rats normalized the alterations in lipid peroxidation and oxidative stress (Anuradha and Ravikumar 6). In different green plant parts of fenugreek, maximum phenolic content and flavonoid contents were observed in distilled water extract followed by methanol and ethyl acetate. Cryogrinding techniques improves its antioxidant activity and retains medicinal properties by prevent molecules which good for human health (Saxena *et al.*, 61; Saxena *et al.*, 63). The ability of fenugreek as functional food tested by determining the lipid peroxidation (LPO), and cyclooxygenase enzyme (COX) inhibitory activities of hexane, ethyl acetate, methanolic and water extracts. The extracts inhibited the LPO by 50-95%, CCOX-1 by 6-87 % and COX-2 by 36-70 % respectively (Yunbao *et al.*, 77).

Ulcer: It is worth noting that fenugreek protects ulcer formation in rats via decreasing gastric volume, ulcer index value, total acidity, lesion formation and curative ratio by markedly increasing the level of mucus secretion (Al-dalain *et al.*, 4). It may be due to the cytoprotective action of fenugreek can be attributed to the presence of flavonoids; which exert their anti ulcer effect.

Inflammation: Fenugreek reduced paw edema in rats, the presence of alkaloids in extract of fenugreek has been reported to produce anti-inflammatory property by reducing edema in rats (Sharififara *et al.*, 69).

Fenugreek has been reported to accelerate the process of wound healing via its antioxidant potential in rats injured in the posterior neck area (Abdullah *et al.*, 1). It may be suggested that the presence of diosgenin in fenugreek plays a key role in producing anti inflammatory action probably by acting the precursor of various steroid hormones such as progesterone and cortisone; which have set a benchmark for preventing inflammation in various pathological conditions.

Obesity: The beneficial effects of fenugreek fiber was studied in healthy obese subjects which demonstrated that fenugreek administration showed marked increase in satiety and fullness and marked fall in hunger and prospective food consumption with reduced energy intake using visual analog scale which may act supportive for treating acute obesity patients. Galactomannan and unpalatability of the fenugreek fiber is assumed to be responsible for promoting satiety by decreasing the rates of gastric emptying and decreased energy intake respectively (Mathern *et al.*, 37).

Hypertension: It has been elucidated that the administration of fenugreek methanol extract and methanol fraction to rats shows antihypertensive. The essential oil obtained from fenugreek in combination with other essential oils has been employed to reduce systolic blood pressure in spontaneously hypertensive rat (Talpur *et al.*, 73). The aqueous and benzene extract of fenugreek has been found to show diuretic activity in rats; which can be employed to treat hypertension (Rohini *et al.*, 60).

Other Disorders: Administration of fenugreek seed extract to both mice and rats revealed its effect on thyroid hormone that fenugreek inhibits the synthesis of tri-iodothyronine concentration estimated by decrease in serum tri-iodothyronine concentration and T3/T4 ratio and consequently increased thyroxine levels which can be mediated through fenugreek-induced hypoglycaemia (Panda *et al.*, 46). It has been reported that oral treatment with fenugreek reduced the quantity of calcium oxalate deposited in the kidneys induced by 3% glycolic acid in rats; which further supports its use in Saudi folk medicine (Ahsan *et al.*, 2). Fenugreek showed anti-cataract property in sodium selenite-induced cataract in rats by restoring the levels of glutathione, and other antioxidant enzymes such as superoxide dismutase, catalase, etc, in the lens and inhibiting the lipid peroxidation (Gupta *et al.*, 25). The alkaloidal, ethanol and butanol extract of fenugreek has been documented to possess anti-plasmodial activity against *in vitro* culture of chloroquine sensitive and resistant *Plasmodium falciparum* (Palaniswamy *et al.*, 45).

Conclusion

The different forms of cumin possess many remarkable health benefits, viz., anti-diabetic, antimicrobial, antiseptic, and antioxidant, inhibition of blood platelet aggregation etc. The flavanoids apigenin, luteolin, and their glycosides present in cumin are reported to be responsible for many of the biological activities of cumin. Cuminaldehyde, the major constituent of volatile oil, is responsible for the antimicrobial and anti-mutagenic

properties. Spent residue from cumin has the potential as a new source of dietary fiber which can be utilized for incorporation into many food formulations.

Coriander volatile oil is rich in beneficial phytonutrients and the seeds have a health-supporting reputation that is high on the list of the healing spices and has been used as antispasmodic, carminative, stimulant, cytotoxic, lipolytic, fungicidal and stomachic compound. Coriander also possesses hypoglycemic, hypolipidemic, antibacterial, antimutagenic activity, insecticidal and aflatoxin controlling effects. Besides, coriander also possesses many other traditional health benefits. The healing properties of coriander can be attributed to its exceptional phyto-nutrient content. Considering these potentials, coriander biomolecules possess a tremendous future in the health-related industry.

Fennel has been used as food and medicine with long history in central Europe and Mediterranean region as well as in China. It is also a flavor food with health value. Numerous compounds including *trans*-anethole, estragole, fenchone, sesquiterpenoids, coumarins and polyphenolics were isolated from this plant, most of which exhibited significant bioactivities. The fennel has potential beneficial therapeutic actions in the management of bacterial and fungal infections and colic pain. Both the fruit and whole plant of this plant might be the source of chemical and biological materials in future. For further utilization of this plant, systematic phytochemical and biological mechanistic studies are needed.

Fenugreek has an extensive variety of actions which are likely to protect the human body against a variety of insults. Fenugreek has the potential to ameliorate diabetes mellitus exhibited by stimulating glycolytic enzymes, inhibiting gluconeogenesis. Further, the exaggerated action of fenugreek in treating cancer has been demonstrated through various mechanisms such as induction of apoptosis, inhibition of cell proliferation and arachidonic acid pathway. Increasing body of evidences suggests that oxidative stress plays a vital role in the induction and progression of various disorders such as atherosclerosis, Parkinson's disease, heart failure, myocardial infarction and Alzheimer's disease. But the promising antioxidant effect of fenugreek needs to be explored in these diseases. In spite of various pleiotropic actions of fenugreek on chronic disorders such as obesity, inflammation, hypertension and ulcers, the relevant clinical applications of fenugreek is still in the queue of thir area of research. Therefore, more focused research on specific experimental models, human trials and an understanding the mechanism of action is necessary.

Table.1: Brief health potential uses of major seed spices.

Seed Spices	Major phytochemicals	Medicinal uses
cumin	cuminaldehyde , -pinene, -terpinene	Gastrointestinal, reproductive, nervous and immune system. Antimicrobial, antioxidant and chemoprotective activity.
coriander	Linalool, carvone, geraniol, limonene, borneol, camphor, elemol	Digestive, carminative, diuretic, tonic, stimulant, stomachic, refrigerant, aphrodisiac, analgesic, anti-inflammatory, antioxidant, insulin-like and anti-spergillus activity.
Fennel	Anethole , fenchone, phenols	Aromatherapy, antioxidant, hepatoprotective, anticancer, Stimulant, carminative, stomachic, emmenagogue, refrigerant, cardiac stimulant, antiemetic, aphrodisiac, anthelmintic , antimicrobial
Fenugreek	steroidal saponins (diosgenin), Galactomanan, 4-HIL	Carminative, tonic, aphrodisiac, emollient, antibacterial, used in vomiting, fever, anorexia, colonitis, complementary medicines for cancer therapy and diabetes and oral contraceptive.

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