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# Utilization of various seeds: A review

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**Abstract**
Seed, known to be an embryo possessing part of a plant, enclosed in a protective outer covering, does not have much utilization known to us. Seeds which are generally thrown away as a waste product have various benefits hidden among themselves. In this review paper, seeds and their different utilizations have been highlighted. We see that seeds, because of their concealed polyphenols and antimicrobial activities, serve us with various medicinal purposes. By-products such as seed flour and seed oil derived from them are enriched with nutrition value and antioxidant properties. Thus, instead of being wasted and withered, proper utilization of seeds should be done.

**Keywords:** embryo, polyphenols, antimicrobial activities, seed flour, seed oil

## 1. Introduction
Seed has been considered as a waste product dumped from households or fruit/vegetable processing industries. But seeds have found their utilization in food, pharmaceutical and cosmetic industries for their antioxidant and medicinal values. Besides, seed can used for processing of seed flour, seed oil and can be utilized as a source of various polyphenols and flavonoids. The parts of the plant most commonly used for the therapeutic purposes in the "Alternative Medicinal" systems are the seeds which are contained in an inflated capsule formed from the united follicles containing considerable amount of oil having pungent and bitter taste. (Padhye *et al.* 2008). (Umbelliferae). Essential oil of fennel is used as flavoring agents in food products such as beverages, bread, pickles, pastries, and cheese. It is also used as a constituent of cosmetic and pharmaceutical products (Piccaglia *et al.*, 2001) [75]. Herbal drugs and essential oils of fennel have hepatoprotective effects (Ozbek *et al.* 2003) [71], as well as antispasmodic effects. They are also known for their diuretic, anti-inflammatory, analgesic and antioxidant activities (Choi, E, 2004) [31] (Anand *et al*, 2008) [5] reported that fennel seed possesses anticancer activity.
In general, the use of food parts usually discarded by industries adds nutrients to various preparations. (Storck *et al.* 2013) [84-89], elaborated preparations using papaya seed cake and papaya peel jam and observed an increased fiber content and sensory analyses were conducted. *Sesamum indicum* L. (Pedaliaceae) is an annual shrub with white bell-shaped flowers with a hint of blue, red or yellow with branches or without branches. It is grown for the production of seeds which is rich in oil content. (Chakraborty *et al.* 2008). Commonly the seeds are used primarily as a spice and food preservative. In folk medicinal practices they are ingested with food or mixed with honey and are primarily used as lactogogues, carminitative and antihelmnthic agents. The seeds have also been used as diuretics, anti-hypertensive, muscle relaxants and as immunity enhancers in immune- compromised people. Importantly, the seeds have been reported to be safe when used orally in moderate amount in food (Der Marderosian. *et al,* 2005) [34]. Several beneficial pharmacological effects have been attributed to various crude or purified components of these seeds including antihistaminic (Chakravorty, 1993) [30], antihypertensive (Zaoui *et al.*, 2000) [98], hypoglycemic (Al-Hader *et al.*, 1993) [1], antifungal (Khan *et al.*, 2003) [51], anti-inflammatory (Al-Ghamdi, 2001) [9] along with significant anti-neoplastic (Worthen *et al.*, 1998) [96] activities. These studies collectively provide early indication that further development of agents derived from black cumin seeds could be useful in modern medicine.
The chemical composition of fenugreek seed (FS) has been thoroughly studied and its medicinal properties are associated with its phytochemicals such as galactomannans, phenolic compounds, alkaloids, proteins, vitamins (A, B1, C and nicotinic acid) and volatile oils

(Acharya *et al.*, 2008) [6]. Germinated fenugreek seeds rich in bioactive antioxidant substances are also used extensively as an important ingredient in daily food preparations and herbal formulations (Khole *et al*., 2014) [57]. The search for natural sources of antimicrobial and antioxidant substances is on great demand. Plants have been used in traditional medicines for several years. Herbs and spices are well known to have antioxidant properties 1 and are being explored for their possible role in food processing, neutraceutical and pharmaceutical industry. (Dua *et al.*, 2014) [39]. Recently there has been considerable interest in the antimicrobial potential of fennel seed extracts and essential oil. (Dua *et al.*, 2013) [36-37-38-40]. The seed spices constitute an important group of agricultural commodities and play a significant role in our national economy. 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. (Rathore *et al.*, 2013)
Coriander seeds are used to cure indigestion, cough, bronchitis, vomiting, diarrhea, dysentery, rheumatism and pain in joints. (Dua *et al.* 2014) [39]. In relation to antioxidative properties, spectrophotometric *in vitro* analysis revealed the high oxygen radical scavenging capacitiesof an ethyl acetate (Karviarasan *et al.* 2006) and alcohol fenugreek extracts (Madhava Naidu,Shyamala, Pura Naik, Sulochanamma, & Srinivas, 2011) [66], both ofwhich were shown to possess phenolic content. Further studies have also shown fenugreek seeds to be a rich source of polyphenols, which has led to the quantification of several compounds by HPLC, including apigenin and a number of kaempferol andquercitin gylcosides (Chatterjee, Variyar, & Sharma, 2009) [28-32] as well as the flavonoids; vitexin, tricin, naringenin, quercetin and tricin7-O-b-D-glucopyranoside (Shang, Han, Li, & Zhao, 1998) [85]. Grape seed extract has shownantioxidant activities both *in vivo* and *in vitro*, in various meats (Brannan & Mah, 2007; Cos, De Bruyne, Hermans, Apers, Berghe *et al.*, 2004; Hu, Mc Clements, & Decker, 2004; Shaker, 2006) [24]. The suggested antioxidant activity *in vivo* include stimulating enzyme production of nitric oxide, oxygen radical scavenging and inhibition of nitrositive stress (Bagchi *et al.*, 2000; Roychowdhury, Wolf, Keilhoff, Bagchi, & Horn, 2001a,b) [17, 77]. In meat system, GSE demonstrates the antioxidant activity by reducing the amount of primary lipid oxidation products (e.g. lipid hydroperoxides and hexanal) and secondary lipid oxidation products (e.g. thiobarbituric acid reactive substances—TBARS) (Brannan & Mah, 2007) [24]. GSE has reduced rancid flavor development and antioxidant activities in various meat products like rawbeef, cooked beef, raw and cooked pork patties, turkey, fish oil, frozen fish and ground chicken breast and thigh meat (Ahn *et al*., 2002; Banon *et al*., 2007; Brannan & Mah, 2007; Brannan, 2009; Carpenter *et al*., 2007; Lau and King, 2003; Mielnik *et al*., 2006; Nissen *et al*., 2004; Pazos *et al*., 2004) [24, 23, 59, 67, 69, 74].

### 1.1 Seed Flour

Flour obtained from seeds is found to be rich in nutritional value, dietary fiber and water holding capacity. It also possesses unique functional properties and natural antioxidants. Few such seed have been discussed below.

**1.1.1 Papaya Seed:** It is known that by-products are important sources of sugars, minerals, organic acids, fiber, and phenolic compounds that have a wide range of pharmacological activities, which include antitumor, antiviral, antibacterial, cardioprotective, and antimutagenic activities (Djilas *et al.*, 2009) [33]. Making full use of food is a way to increase daily cooking by creating new recipes such as jellies, pies, juice, and pastries, in addition to nutritionally enriched diets, providing more fiber, vitamins, and minerals (Storck *et al.*, 2013) [84-89]. Papaya is one of the most common fruits in almost all countries in tropical America, and it was discovered by the Spanish in the region between southern Mexico and northern Nicaragua. After its discovery, papaya was widely spread in many tropical regions, extending to 32° north and south latitude, with a possible introduction in Brazil in 1587. It is considered one of the most cultivated and consumed fruits in tropical and subtropical regions in the world. The fruit is an excellent source of calcium, pro-vitamin A, and vitamin C (ascorbic acid); thus, it is widely used in diets (Serrano & Cattaneo, 2010) [90]. Brazil is the second largest world producer of papaya, accounting for 19% of the total production (Informa Economics FNP, 2011). Storck *et al*. (2013) [84-89], elaborated preparations using papaya seed cake and observed an increased fiber content and sensory analyses were conducted.

**Table 1:** Composition of seed flour from Havai and Calimosa Papaya

| | **Havai Papaya Seed** | **Calimosa Papaya Seed** |
|---|---|---|
| Humidity | 5.27 | 5.50 |
| Ash | 6.94 | 7.53 |
| Lipids | 29.72 | 27.99 |
| Protein | 28.55 | 28.09 |
| Soluble Fiber | 5.44 | 5.24 |
| Insoluble Fiber | 3.36 | 2.51 |
| Total Fiber | 8.78 | 7.75 |
| Carbohydrate | 20.73 | 22.94 |
| Vitamin C | 0.15 | 0.12 |
| Phenolic Compounds | 2.66 | 3.01 |

### 2. Seed Oil

Oil, derived from seeds are found to be rich in antioxidants and also have free radical scavenging activities. Some examples are as follows.

**2.1 Date seed:** Date fruit (*Phoenix dactylifera*L) has become an important fruit in some countries as a source of nutrition and economics (Nancib *et al.*, 1997; Bendiab *et al.*, 1998; Al-Qarawi *et al.*, 2003; Awad 2007; Al-Farsi *et al*., 2007; Baliga *et al*., 2010; Briones *et al*., 2011) [68, 10, 11, 12, 18, 19]. Date fruit consists of 73-79% carbohydrates, 14-18% total dietary fibers, 2.5% ash, 2.1-3.0 % protein (Elleuch *et al*., 2008) [44], and 2.0-3.2% fat (Al-Farsi *et al*., 2007) [12]. The date seed have been used traditionally as the animal feed or grinded into smaller size and being roasted to turn it into caffeine-free coffee substitute, which have been commercialized by the Arabs in two types, whether plain or mixed with coffee (Rahman *et al.*, 2007; Al-Farsi and Lee, 2011) [78, 13]. Generally the date fruit can be categorized into several maturity stages. The first stage known as the "hababouk" stage. The second stage known as the "kimri" stage. The third stage called as the "khalal" or "besser" stage. The fourth stage

known as the "rutab" stage and the fifth stage, the "tamar" stage (Al-Shahib and Marshall, 2003a; Baliga *et al*., 2010; Amira *et al.*, 2011) [14, 18, 15]. The weight of the four varieties of date fruit namely Allig, Degla, DegletNour and Gosbi and its seeds decrease as the maturation process takes place from the besser stage through the tamar stage except for the Horra variety, in which the seed weight increases although the fruit weight decreases (Amira *et al*., 2011) [15]. About 11-18% of the date fruit weight comes from the seed (Besbes *et al*., 2004a; Nehdi *et al*., 2010; Amira *et al.*, 2011) [16, 70, 15]. The fat content in the date seed obtained from several studies were range from 5.7 to 12.7% (Besbes *et al*., 2004a; Besbes, 2005; Rahman *et al*., 2007; Habib and Ibrahim, 2009; Nehdi *et al*., 2010) [16, 25, 78, 50, 70].

**Table 2:** Fatty acid composition of Date seed oil (% of total fatty acid)

| Fatty acid | Date seed oil | | | | | | |
|---|---|---|---|---|---|---|---|
| | Deglet Nour | Heat treated Deglet Nour | Allig | Heat treated Allig | Tamirraq | Phoenix canariensis | Roasted date seed |
| Capric (C10:0) | 0.8 | 0.7 | 0.1 | 0.8 | 0.0 | 0.1 | 0.35 |
| Lauric (C12:0) | 17.8 | 31.7 | 5.8 | 34.2 | 13.1 | 10.2 | 38.8 |
| Myristic (C14:0) | 9.8 | 14.0 | 3.1 | 15.7 | 11.0 | 7.5 | - |
| Palmitic (C16:0) | 10.9 | 10.6 | 15.0 | 13.8 | 11.8 | 9.8 | 15.1 |
| Stearic (C18:0) | 5.7 | 3.9 | 3.0 | 4.24 | 2.8 | 1.7 | - |
| Oleic (C18:1) | 41.3 | 34.5 | 47.7 | 26.3 | 52.2 | 50.1 | 36.5 |
| Linoleic (C18:2) | 12.2 | 3.3 | 21.0 | 0.3 | 7.1 | 19.2 | 9.2 |
| Linolenic (C18:3) | 1.7 | 0.7 | 0.8 | 1.9 | - | 0.1 | - |

**2.2 Citrus fruit seed:** Citrus species and 1300 of other species, classified in 140 genera, are members of the family Rutaceae. The fruit is grown mainly in south of Iran which is characterized with warm and humid climate, which is perfect for growing citrus (I. A. Khan *et al.,* 2007) [78]. Currently only the juice of the fruit is commercially used and the seeds are considered as waste. In general, peels, seeds, and pulps (around 50% of the fruit) are dealt with as wastes, while, potentially, they can be source of valuable byproduct (T. A. El-Adawy, E.H.Rahma, A.A.El-Bedawy, and A.M. Gafar, 1999) [91]. Given the economic, medical, and dietary values of citrus seed oil, there has been a recent surge of studies on the chemical composition (fatty acid content in particular) of the oil of seeds of different species of *Citrus*. Many works have measured the oil content of citrus seeds: Tunisian citrus seeds (26.1–36.1%) (M. Sa¨ıdani, W. Dhifi, and B. Marzouk, 2004) [61], Brazilian Rangpur lime seeds (32.0–38.3%) (S. Y. Reda, E. S. Leal, E. A. C. Batista *et al.,* 2005) [87], Egyptian citrus seeds (40.2–45.5%) (M. A. Habib, M. A. Hammam, A. A. Sakr, and Y. A. Ashoush, 1986) [62], Tunisian sweet orange (51.8%) and lemon seeds (78.9%) (M. Sa¨ıdani,W. Dhifi, and B. Marzouk, 2004) [61], and Pakistani citrus seeds (27.0–36.5%) (F. Anwar, R. Naseer, M. I. Bhanger, S. Ashraf, F. N. Talpur, and F. A. Aladedunye, 2008) [45].

**Table 3:** Fatty acid compositions of the oils extracted from different citrus seed species (%)

| | Palmitic | Palmitoleic | Stearic | Oleic | Linoleic | Linolenic | Other fatty acids | Oil content |
|---|---|---|---|---|---|---|---|---|
| **Qaleh Ganj** | | | | | | | | |
| Lemon | 29.4 | 0.7 | 4.7 | 26.4 | 34.1 | 6.2 | 0.5 | 41.5 |
| Citrus | 27.6 | 0.6 | 6.5 | 27.1 | 34.0 | 3.2 | 1.0 | 34.1 |
| **Jiroft** | | | | | | | | |
| Lemon | 27.8 | 0.9 | 4.1 | 24.8 | 35.7 | 7.0 | 0.6 | 41.9 |
| Citrus | 27.3 | 0.4 | 4.8 | 29.3 | 36.3 | 3.3 | 0.9 | 37.2 |
| **Anbarabad** | | | | | | | | |
| Lemon | 23.5 | 0.6 | 4.2 | 28.5 | 33.7 | 7.8 | 1.4 | 40.3 |
| Citrus | 26.5 | 0.6 | 6.5 | 28.6 | 32.2 | 4.1 | 1.5 | 33.4 |

**2.3 Pumpkin seed:** The extract of the seed is a rich source of vitamins, linoleic acid, oleic acid, and microelements. Especially, the oil extracted from Cucurbitapepo has been useful for the treatment of urinary disorders. The effect of the pumpkin seed oil from C. pepo has been investigated in clinical trials involving over 2000 men suffering from Benign Prostate Hypertrophy (BPH) (Friederich M, Theurer C, Schiebel-Schlosser G, 2000) [46]. The oil significantly improved the urinary dysfunction. In an animal study, Gossell-Williams *et al.* demonstrated that oil from the pumpkin seed of C. pepo inhibited testosterone-induced hyperplasia of the prostate of rats (Gossell-Williams M, Davis A, 2006) [47]. In Japan, especially in Hokkaido, Cucurbita maxima is the main pumpkin species grown for food. Thus, numerous pumpkin seeds are available here. Ojiako *et al.* have analyzed the composition of seeds of C. maxima as having various fatty acids, proteins, carbohydrates, and minerals (Ojiako OA, Ogbuji CA, Agha NC, Onwuliri VA, 2010) [73]. The effect of pumpkin seed oil from C. maxima by OABSS. The OABSS was remarkably reduced in subjects given pumpkin seed oil extracted from C. maxima. The effect of pumpkin seed oil obtained from C. pepo has been tested in urinary disorders and this oil is now being developed for self-medication in western countries. Friederich *et al*. have demonstrated that the pumpkin seed extract obtained from C. pepo improves abnormal urinary function in patients with BPH (Friederich M, Theurer C, Schiebel-Schlosser G, 2000) [46].

**Table 4:** Fatty acid component of the Pumpkin seed oil extracted from *Cucurbitamaxima* per 100g

| Myristic | Palmitic | Palmitoleic | Margaric | Stearic | Oleic | Linoleic | Linolenic | Arachidic |
|---|---|---|---|---|---|---|---|---|
| 0.1 | 10.9 | 0.1 | 0.1 | 6.0 | 38.6 | 37.8 | 0.2 | 0.5 |

**3. Polyphenols from Seeds**

Polyphenols are generally phytochemicals which act as antioxidants by protecting cells and body chemicals of humans against damage caused by free radicals and reactive atoms. Polyphenols are common to many plants and their parts have evolved as antibacterial and antioxidant agent against environmental stress due to a variety of oxidizing and potentially harmful free radicals (Garg *et al*. 2013) [36-40]. Utilization of plant extracts as an alternative to chemical or synthetic antimicrobials and antioxidants to combat the food-borne pathogens, inhibiting lipid oxidation and thus extending the shelf life is an increasing trend in the food industry (Perumalla & Hettiarachchy, 2011). Seed and seed extracts also have a large variety of polyphenols hidden among them. A few examples of such polyphenol rich seeds have been highlighted here.

**3.1 Grape seed:** One such polyphenol rich seed are grape seeds which yields about (5-8) % of polyphenols (Johnshi & Jianmel, 2004). Standardized grape seed extracts contain 74 to 78% oligomeric proanthocyanidins on a dry weight basis (Burdock, 2005) [22]. Proanthocyanidins in the form of monomeric phenolic compounds, such as catechin, epicatechin and epicatechin-3-O-gallate, are rich in Grape seed extract as reported by Perumalla and Hettiarachchy (2011). The red colour and astringency taste of the Grape Seed Extract can be attributed to polyphenol rich compounds especially proanthocyanidins (Monteleone *et al*., 2004; Weber *et al*., 2007) [64, 97].

**3.2 Mustard seed:** Again in mustard seeds, the main polyphenolic compounds found are benzoic and cinnamic acids and their derivatives, mainly cholin esters. More than 70% of total phenolic content is sinapin, the cholin ester of sinapic acid. The antioxidant properties of mustard are connected with thisrich phenolic content and composition beside the tocopherol compounds (Ildiko *et al*. 2006)

**3.3 Coffee and cocoa seed:** Another such example of polyphenol rich seeds are coffee and cocoa seeds. Chlorogenic acid is the main phenolic constituent of coffee seeds. The major polyphenol in cocoa seeds is flavanol epicatechin, and cocoa seeds are anthocyanins and tannins (Bravo, 1998).

**3.4 Guava seed:** *(Psidium guajava)***:** According to Joseph and Mini priya (2011) [26], guava seeds are rich in flavonol glycoside, quercetin-3-β-D-(2''-O-galloyglucoside)-4'-O-vinylpropionate.

**3.5 Fenugreek seed:** (*Trigonella foenum graecum):* Studies have shown fenugreek seeds to be,also a rich source of polyphenol. Such polyphenols in fenugreek seeds include apigenin and a number of kaempferol and quercitin glycosides (Chatterjee *et al*. 2009) [28-32] as well as flavonoids; vitexin, tricin, naringenin, quercetin and tricin-7-O-β-D-glucopyranoside (Shang *et al*. 1998) [85].

**3.6 Fennel seed:** (*Foeniculum vulgare Miller*): Experiments conducted using the methanolic extract of dry fennel seeds identified polyphenols such as gallic acid, caffeic acid, ellagic acid, quercetin and kaempferolin abundance (Dua *et al*., 2013) [36-37-38-40]

**3.7 Coriander seed:** (*Coriandrum sativum*): Also, polyphenols such as gallic acid, caffeic acid, ellagic acid, quercetin and kaempferol were abundantly found in the coriander seeds. Isoquercetin, rutin and their glucuronoid derivatives have also been identified from coriander seeds (Dua *et al*. 2014) [39].

**4. Medicinal Seeds**

Seed 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. Even today, these metabolites are a major source of new drugs (Rathore *et al.*, 2012) [79]. They are classified by functional groups, e.g. alcohols, aldehydes, amines, esters, ethers, ketones, terpenes, thiols and other miscellaneous compounds. In seeds, the volatile oils constitute these components (Zachariah *et al.* 2010) [100].

**4.1 Cumin (CuminumcyminumL.)**

Cumin is a seed spice belonging to the family umbelliferae. 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 (Rathore *et al*. 2013). *Shaath and Azzo* (1993) [93], reported that the main constituents of cumin seed oil were cuminaldehyde which is responsible for its characteristic odour. According to *Borges and Pino (1993)* [21]. 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.

**4.1.1 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, 1980*) [34]. Cuminaldehyde has been demonstrated to scavenge the superoxide anion (*Krishnakanthaand Lokesh, 1993*) [52]. The total phenolic content of methanolic extracts of different cumin varieties (cumin, black cumin and bitter cumin) ranged from 4.1 to 53.6 mg/g dry weight (*Thippeswamy and Naidu, 2005*) [92].
- **Anticancer Effects:** The cumin seed 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.,* 2003) [49]. Anticarcinogenic effects of Cumin seeds was shown in benzopyrene induced forestomach tumours in animals (*Badaray et. al.*, 1999) [20].
- **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.,* 1998) [94].
- **Antimicrobial:** 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.,* 2007).

### 4.2 Coriander (*Coriandrum sativum* L.)

*Coriandrum sativum* L. is an important spice crop and occupies a prime position in flavoring substances. Coriander seeds contain petroselinicacid (68.6%), linoleic acid (16.6%), oleic acid (7.5%) and palmitic acid (3.8%) Major components of essential oil are linalool (67.75%), a-pinene (10.5%), camphor (3%) and geraniol (1.9%) (Ullagaddi and Bondada, 2011).

#### 4.2.1 Medicinal and Pharmacological Properties

- **Antioxidant activity:** It was suggested that addition of coriander to food would increase the antioxidant content and may have potential as a natural antioxidant and thus inhibit unwanted oxidation processes (*Wangensteen*, 2004) [95].
- **Hypoglycemic:** 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 (El-Soud *et al*., 2007) [41-43].
- **Hypolipidemic:** 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., 2005*) [42].

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., 1977*) [56]. Coriander is good in iron content which directly helps curing anemia.

### 4.3 Fennel (*Foeniculum vulgare* Mill.)

Sweet fennel (*Foeniculum vulgare* Mill.) contains volatile oils (trans-anethole, thymol, fenchone, carvacrol, terpinene, P-thymene and thymolmethyl ether), phenolic glycosides, flavonoids, phytosterols, triterpines, saponins (Ph. Eur. 2005). Sweet fennel is an estrogenic (*Albert-Puleo*, 1980*; Malini et al.,* 1985*; Annusuya et al.,* 1988) [7, 63, 8], lactagouge, diuretic, antioxidant; immune booster is useful in dyspepsia. Fennel and its herbal drug preparations are widely used for dyspeptic complaints such as mild, spasmodic gastric-intestinal complaints, bloating and flatulence (*Chakurski et al.,* 1981) [29]. Different studies had shown that the extract of Foeniculumvulgare is effective in the treatment of colic in breastfed infant (*Alexandrovich et al., 2003; Savino et al., 2005*) [4, 80].

#### 4.3.1 Medicinal and Pharmacological Properties

- **Antioxidant activities**: Fennel was known as excellent sources of nature antioxidants and contributed to the daily antioxidant diet (*Shahat et al.,* 2011) [81]. The volatile oil showed strong antioxidant activity in comparison with butyratedhydroxyanisole (BHA) and butylatedhydroxytoluene (BHT) (*Singh*, 2006) [82].
- **Hepatoprotective activity:** Fennel essential oil could inhibit the $CCl_4$ induced acute hepatotoxicity. D-limonene and β-myrcene of the oil might be the potential candidates (*Ozbek et al., 2003*) [71].
- **Estrogenic activity:** Fennel oil was reported to exhibit estrogenic activity, promote menstruation, alleviate the symptoms of female climacteric, and increase libido (*Albert-Puleo, 1980)* [7].

### 4.4 Fenugreek (TrigonellafoenumgraecumL):

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 andcarpaine; flavonoids;free amino acids; 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*, 2008) [58]. Fenugreek (Trigonellafoenumgracum) seeds can decrease lipid peroxidation, a common phenomenon during carcinogenic process, in dimethylhydrazine induced Wister rats (*Genet et.al.* 2002) [48].

#### 4.4.1 Medicinal and Pharmacological Properties

- **Diabetes Mellitus:** The fenugreek alkaloidal extract prevente 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 (*ElSoud et al., 2007*) [41-43]. 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, 2006*) [65]. It has been documented from various studies that saponins and diosgenin present in fenugreek are responsible for hypolipidemic and anti-diabetic action on hypercholestrolaemic rats (*Stark and Madar 1993*) [88].
- **Cancer:** The effect of fenugreek seeds observed in induced breast cancer in rats (Amin *et al.,* 2005), 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* 2007) [86].
- **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.,* 2005) [55]. 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.,* 2004).
- **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.,* 2009).

**Table 5:** Brief health potential uses of major seed.

| Seeds | Major phytochemical | Medicinal use |
|---|---|---|
| cumin | cuminaldehyde, β-pinene, γ-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, antiinflammatory, antioxidant, insulin-like andanti-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. |

(***Source*:** Rathore *et al.*, 2013)

## 5. Conclusion

Role of seeds as antibacterial agent grants itself good potential to be applied in the food and pharmaceutical industry (Dua *et al.*, 2014) [39]. Various studies that have been conducted on seed found that it can be as an excellent source of dietary fiber. In addition, the other component such as protein and minerals also present in considerable amount in seeds. Based on the fatty acid composition of different seed oil, it is suggested the use of this oil for nutritional purpose, as edible cooking oil and also for the production of margarine due to the high stability and resistance of seed oil to thermal treatment which indicate the good shelf life and storability of this oil even for a long period of time. (Abdu Afiq *et al*. 2013) [2]. The peel flour from *Havai* and *Calimosa* papaya had higher concentrations of vitamin C (3.37 and 2.96 mg $g^{-1}$) than that of the seed flour (0.15 and 0.12 mg $g^{-1}$). Oliveira *et al.* (2011) [72] found an average content of vitamin C of 0.80 mg $g^{-1}$ for the fresh pulp of *Formosa* papaya. The amounts of vitamin C in the present study, based on fresh matter, found in the peel flour (0.44 and 0.40 mg $g^{-1}$) and in the seed flour (0.007 and 0.006 mg $g^{-1}$) for the cultivars *Havai* and *Calimosa*, respectively, showed that the pulp is richer in vitamin C than the flours.

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