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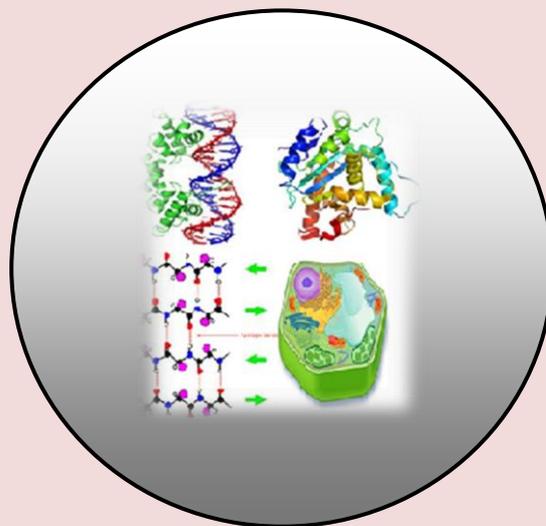
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ABSTRACT

*Apart from being used for adding flavor, it is also used for various health benefits that are derived from its anti-oxidants. These anti-oxidants are essential to curb unwanted free radical reactions in the body. This phenomenon also prevents many diseases that can get serious at a later stage. Some of the antioxidants listed in these seeds are kaempferol and quercetin that are known to prevent degenerative reactions. Fennel seeds contain a good amount of dietary fiber that is essential for the body. The fiber content helps improve digestion in the body, by facilitating timely breaking down of food molecules that make energy reactions possible. The carcinogenic diseases should be treated at the right stage so that their effect can be curbed or eliminated in the future. Fiber present in fennel seeds decreases reabsorption of cholesterol, thereby preventing any heart-related diseases. A number of volatile oil compounds like myrcene, fenchone, chavicol, cineole are present in these seeds that assist in digestive, carminative, and antioxidant reactions in the body. Production of Red Blood Cells is enhanced by the consumption of Fennel Seeds. Copper, which is required by the body for the production of red blood cells, is present in these seeds. Zinc, found in the fennel seeds, promotes regular growth and development. The potassium content helps in maintaining the blood pressure and hence the heart rate is also maintained. The review aims to gather the fragmented information available in the literature regarding morphology, ethnomedicinal applications, phytochemistry, pharmacology, and toxicology of *Foeniculum vulgare*. It also compiles available scientific evidence for the ethnobotanical claims and to identify gaps required to be filled by future research. Findings based on their traditional uses and scientific evaluation indicates that *Foeniculum vulgare* remains to be the most widely used herb globally.*

Keywords: Cholesterol, Myrcene, Fenchone, Chavicol, Cineole and Carminative.

INTRODUCTION

Fennel is an aromatic herb belonging to the parsley family. It is used as a spice and possesses a sweet taste that is similar to anise. It is an essential ingredient in the Mediterranean cuisine. It is native to the South European region but is consumed well in all of the European regions. It is a two-meter plant with dark green leaves and yellow flowers. Fennel seeds are not only tasty but are also very healthy owing to their nutritional content. Fennel bulb is also eaten as a vegetable in some parts of the Mediterranean region [Ono et al., 1995, Muckensturm et al., 1997, Kaur and Arora, 2009, Manonmani and Abdul Khadir, 2011]. Saunf or Fennel seeds are an edible and healthy seeds used for many years in cooking as well as medicinal purposes. It is also called as moti saunf in India. It belongs to the Apiaceae or Umbelliferae family and *Foeniculum* genus, cultivated in many countries all over the world. India is the top producer of the saunf however it is cultivated in average amount in Iran, Mexico, China, Canada, Syria, Bulgaria, United States, Australia and etc. Saunf or Fennel seeds are an edible and healthy seeds used for many years in cooking as well as medicinal purposes. It is also called as moti saunf in India. It belongs to the Apiaceae or Umbelliferae family and *Foeniculum* genus, cultivated in many countries all over the world. India is the top producer of the saunf however it is cultivated in average amount in Iran, Mexico, China, Canada, Syria, Bulgaria, United States, Australia and etc. [Orhan et al., 2012, Dua et al., 2013, Ozbek et al., 2003, Oktay et al., 2003].

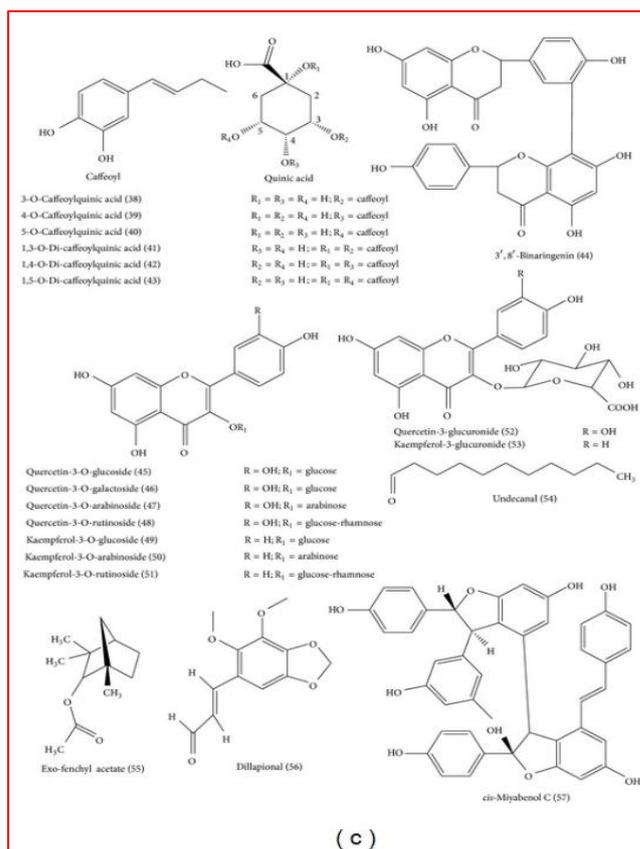
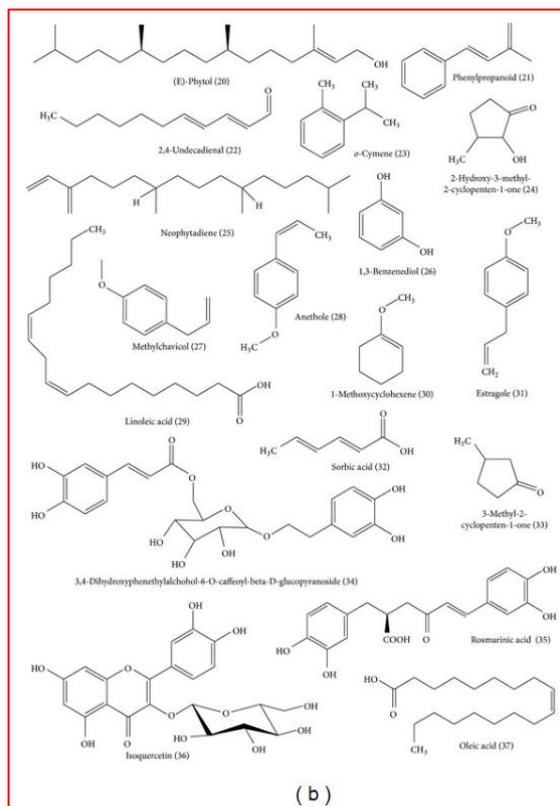
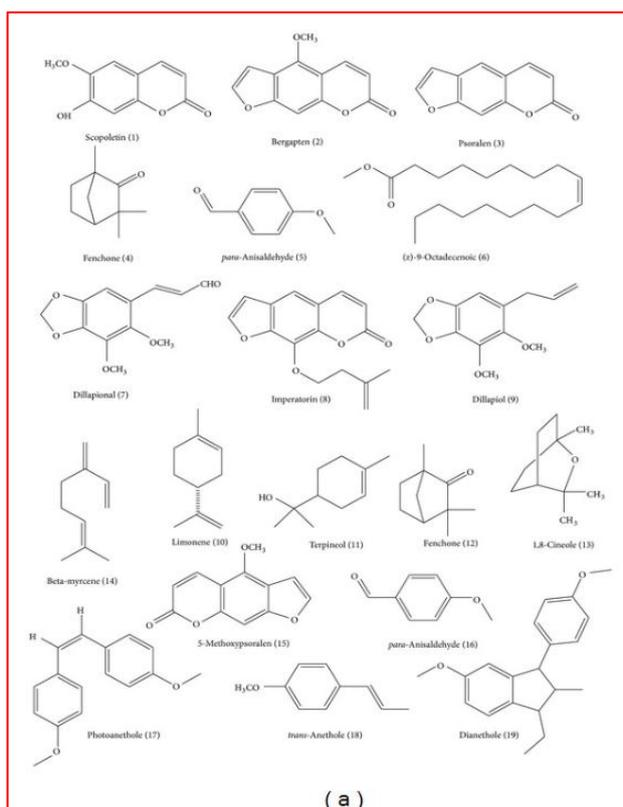


Fennel herb and seeds

In India, it is an old and most common trend of offering some fennel seeds with mishri (or sugar coated saunf) after a meal to chew. It is mostly carried out in hotels, restaurants and parties in order to prevent after eating problems like gas, indigestion, acid reflux, abdominal cramps, flatulence, and constipation. DO not be confused with the fennel seeds (moti saunf with green or yellowish color, used for cooking purpose) and aniseeds (patli or chhoti saunf with green color, used for raw eating purpose after meal) [Barros et al., 2010, Garg et al., 2009].

Phytochemical constituents

Phytochemical research carried out on *Foeniculum vulgare* has led to the isolation of fatty acids, phenolic components, hydrocarbons, volatile components, and few other classes of secondary metabolites from its different parts. Mostly these phytochemicals [(a,b,c,d)1-60] are found in essential oil [He and Huang et al., 2011, Jamwal et al., 2013].





MEDICINAL PROPERTIES

Apart from being used for adding flavor, it is also used for various health benefits that are derived from its anti-oxidants. These anti-oxidants are essential to curb unwanted free radical reactions in the body. This phenomenon also prevents many diseases that can get serious at a later stage. Some of the antioxidants listed in these seeds are kaempferol and quercetin that are known to prevent degenerative reactions. Fennel seeds contain a good amount of dietary fiber that is essential for the body. The fiber content helps improve digestion in the body, by facilitating timely breaking down of food molecules that make energy reactions possible. The carcinogenic diseases should be treated at the right stage so that their effect can be curbed or eliminated in the future. This is made possible by the antioxidant capabilities of the fennel seeds [Telci et al., 2009, Díaz-Maroto et al., 2006, Gross et al., 2009]. Another effect of prevention of free radical reactions by fennel seeds – Neurological diseases are helpfully kept at bay. Cholesterol absorption in the arteries is prevented by the action of the fiber binding to the bile salts. Fiber present in fennel seeds decreases reabsorption of cholesterol, thereby preventing any heart-related diseases. A number of volatile oil compounds like myrcene, fenchone, chavicol, cineole are present in these seeds that assist in digestive, carminative, and antioxidant reactions in the body. Production of Red Blood Cells is enhanced by the consumption of Fennel Seeds. Copper, which is required by the body for the production of red blood cells, is present in these seeds. The growth and development of the body are geared up. Zinc, found in the fennel seeds, promotes regular growth and development. These days, when people face tensions in their day to day lives, it is very important to maintain the blood pressure and keep the heart rate balanced. Fennel Seeds help a lot in this process. The potassium content helps in maintaining the blood pressure and hence the heart rate is also maintained [Guillén MD, Manzanos, 1996, Senatore et al., 2013, Esquivel-Ferriño et al., 2012]. Fennel juice is an extremely nutritional beverage. It contains vitamin A, B, C, E, and beta-carotene. It is a rich source of minerals like magnesium, iron, cobalt, potassium, phosphorus, sodium, silicon, and zinc. It also provides high levels antioxidants, carotenoids, and flavonoids. It contains anethole, a phytonutrient that provides fennel juice its strong aroma. The high levels of antioxidants neutralize free radicals in the body, preventing cell damage. Fennel juice has a calming effect on the intestine.

The anti-spasmodic properties of fennel juice can reduce intestinal cramps, bloating, and flatulence. The essential oils present in fennel juice stimulate the secretion of digestive juice, reducing stomach inflammation. It also improves the absorption of nutrients from the foods we eat. Fennel juice is widely used as an antacid. The roughage in fennel juice balances the digestive tract, promoting regular bowel movements. Fennel also reduces bad bacteria and increases good bacteria in the gut. [Diao et al., 2014, Faudale et al., 2008, Nassar et al., 2010].



Fennel Tea

The high concentration of iron and histamine in fennel juice makes it a good natural remedy for anemia. Regular consumption of fennel juice increases the production of hemoglobin in the body, reversing anemia. It also prevents the formation of blood clots in the body. Fennel contains several essential nutrients, which helps to improve vision. The antioxidants and amino acids in fennel juice rejuvenate the eyes, preventing macular degeneration. Fennel juice, when applied to the eye, can reduce eye irritations and fatigue. The flavonoids present in fennel juice are very useful in preventing oxidative stress, which helps to prevent macular degeneration. The diuretic properties of fennel juice help to remove the toxic substance from the body through frequent urination. This helps to reduce inflammation that causes rheumatism and swelling. It also prevents the formation of kidney stones. Fennel juice contains phyto-estrogen, a chemical that is similar to the hormone estrogen in structure. Thus, fennel juice is very useful for women suffering from menopause and pre-menstrual problems. It also contains folate, which prevents birth defects in unborn babies. Fennel juice eases menstruation problems by regulating hormonal actions in the body. Lactating mothers can regularly drink fennel juice to increase milk production. Fennel juice is believed to release endorphins into the bloodstreams, which relieve depression associated with certain diseases and creates a mood of euphoria. Potassium in fennel juice increases brain function and the cognitive abilities of the brain. In addition to this, fennel juice is also a vasodilator, which increases oxygen supply to the brain and delays the onset of dementia. Fennel essential oil is an aperitif. It helps boost appetite. So if you think you aren't feeling hungry when it is required, fennel essential oil is what you should turn to! Spasms are violent and involuntary contractions of the organs, respiratory tract, intestines, muscles, and nerves. It can lead to chronic cough and acute pain and inflammation. Severe cases of spasms can lead to fainting and even death. Fennel essential oil is an active antispasmodic agent, which relaxes the intestines, muscles and nerves. It provides instant relief from spasms [Cherng et al., 2008, Ghanem et al., 2012, Albert-Puleo, 1980, Abdul-Ghani and Amin, 1988, Choi and Hwang, 2004].

Fennel essential oil contains many chemicals, which exhibit antiseptic and bactericidal characteristics. Fennel oil helps prevent wounds from turning septic. Fennel essential oil prevents tetanus and other post-surgical infections as well.

Fennel essential oil is an active carminative agent. It helps release gas from intestines and provides relief from stomach problems like pain, restlessness, heartburn and indigestion. It also inhibits the formation of gas and helps treat excessive flatulence. Fennel bulb exhibits strong anti-inflammatory properties. Whether you talk of inflammation that is internal or external, fennel bulb cures both. This magic food contains anethole. Anethole serves as a very strong anti-inflammatory flavonoid. It easily cures inflammation caused in humans without causing any side-effects. Fennel bulb offers natural cooling and neutralizing benefits. Thus, it is used to treat the problem of acidity in the duodenum. It makes intestines active and eases the process of absorption. Hence, the toxins get separated from useful minerals. The separated toxins are easily flushed out of the body. Hence, the normal pH level is restored which results in relief from acidity. Vitamin C is a natural immunity boosting vitamin for humans. Fennel bulb is highly rich in vitamin C. Hence; its regular intake strengthens the immune system. It keeps the body safe from minor infections naturally. It also increases the body's capacity to fight back major infections. This is because – stronger immune system means active WBCs. As soon as some infection enters the body, the WBCs engulf all the disease-causing bacteria and viruses and destroy them. Fennel bulb is a rich source of cineole [Joshi and Parle, 2006, Gulfranz et al., 2008, Özcan et al., 2006]. Cineole is an active agent that potentially clears nasal blockages. Thus, it is a boon for people suffering from congestion, asthma, and bronchitis. Cineole efficiently clears and controls the formation and accumulation of phlegm in the chest and nasal passage. Hence, it eases respiration. Fennel bulb is a rich source of potassium. Potassium is an active component of cranial nerves. It is also an active compound that maintains the electrolytic balance of the brain. Moreover, potassium is also a memory charger. In short, fennel bulb ensures proper functioning of the human brain by regulating the levels of potassium. It sharpens the memory and improves focus and concentration. Fennel bulb can regulate hormonal changes in the human body. Its mild analgesic benefits work like a boon to control and cure menstrual pain in women. We all want to have healthy skin and hair but the mere thought of money and time involved in a beauty regime is enough to put us off. But what if I told you that you can stay beautiful with the help of a tiny thing called the fennel seed? Fennel seeds not only impart a special flavor to those gastronomic delights brewing in your kitchen, but can also be utilized for achieving a flawless skin and healthy hair. Yes, you got that right! Fennel seeds can be beneficial for your skin and hair. Fennel seeds are inexpensive and readily available. Loaded with minerals like iron, copper, selenium, potassium, magnesium, zinc and even vitamins like Vitamin C, Vitamin A, and Vitamin E, fennel seeds are also known to be a rich storehouse of dietary fibers, active compounds, and antioxidants. Fennel seeds offer amazing effects for the skin. Not only fennel seeds are antiseptic by nature, but also are loaded with antioxidants. As a result, they help prevent acne, cell damage, while keeping the skin toned. Using fennel seeds as a part of your skin care will help you delay the onset of lines, dark spots and wrinkles. When you consume fennel seeds in one form or the other, you get glowing and flawless skin in return. When consumed, fennel imparts a cooling effect to the skin. It soothes inflammation and skin irritation. Fennel tea, when consumed on a daily basis, helps in improving the overall texture of the skin.

It treats acne and makes your skin look youthful. Fennel seeds, when consumed daily, provide the body with minerals like iron, zinc, selenium and calcium. These minerals are effective in maintaining the oxygen balance, thus imparting healthy skin [Anwar et al., 2009, Park and Seong, 2010, Thakur et al., 2013].

FENNEL HOME REMEDIES

Saunf is an aromatic and sweet flavored seed acts as a mouth freshener and helps in removing bad breath, relief from toothache and gum problems. Eating saunf seeds provides relief from the common cold and cough problems. It is rich source of essential nutrients, fibers, anti-oxidants, vitamins and minerals which promotes courage and strength if consumed regularly. It is a powerful anti-oxidant as it contains some natural antioxidant compound called kaemferol and quercetin which helps in combating with harmful free radicals thus prevents from various degenerative diseases like cancer, aging, neurological diseases and etc. Regular intake of saunf helps in getting relief from the constipation and other digestive problems as it contains high level of dietary fibers which absorbs more water and makes stool soft and ease passage. Dietary fibers found in it helps in lowering the serum cholesterol level as it gets binded with bile salts and reduces its absorption in the colon. Its antioxidant nature protects colon and its mucus membrane from the cancer by inhibiting the growth and development of the cancerous cells. Fennel seed is rich source of essential oil compounds like limonene, anisic aldehyde, myrcene, pinene, fenchone, chavicol, anethole, cineole and etc which make it able to prevent from various health disorders. It is rich source of copper which is highly required by the body to produce red blood cells thus it protects from anemia and other problems caused due to decreased amount of hemoglobin. It is rich source of zinc mineral which acts as a co-factor for many enzymes regulating the growth and development of body, sperm production, nucleic acid synthesis and etc. Fennel seed is rich source of potassium electrolyte which is very necessary for the balance of cells and body fluid as well as controlling heart rate and blood pressure. It is also a rich source of manganese mineral which is the important co-factor for various powerful antioxidant enzymes. Its antibacterial nature protects from the infection of various harmful bacteria including *Bacillus subtilis*, *Cladosporium cladosporioides*, *Aspergillus niger* and etc. It provides relief from the problems of stomach, intestine, colon, irritable bowel syndrome, spleen, kidney and etc. It helps in curing fever by increasing perspiration. Washing mouth with the warm saunf water is very helpful in removing bad breath.

Massaging the muscles on lower abdominal area with the mixture of saunf oil, whole fatty milk, geranium oil and clary sage oil helps in reducing menstrual pain, cramps and PMS disorders. It contains good level of phytoestrogens improving food digestion by soothing the irritable gastric glands. Fennel seed is a good blood purifier helps in purifying blood if a handful of raw saunf is eaten two times a day, morning and evening. It helps in curing heat stroke if saunf water (soaked into water for whole night) is taken by adding a pinch of salt. It helps in promoting proper bowel movements if one teaspoon of the roasted saunf is taken after meals. It is diuretic in nature helps in removing toxic materials from the body as well as provides relief from the body swelling and joints pain during rheumatism and arthritis. It stimulates the secretion of digestive enzymes and juices as well as reduces inflammation of digestive tract thus promote more absorption of the essential nutrients from the food while passing through the alimentary canal.

Regular intake of it helps in recovering digestive system functioning after getting long radiation or chemotherapy treatments. Saunf water acts as a vasodilator thus keeps mind and body stress free and calm by enhancing oxygenated blood flow to the brain and all through the body thus keeps away from depression, dementia and other memory loss problem.

Fennel seed is a most common mouth freshener used in the paan (betel leaf) to make it delicious and flavored to chew. Fennel seed is a natural home remedy to suppress appetite and go for weight maintenance. It has been used for years by the women during their fasting periods to reduce hunger. It is a fat digester and hunger suppressor thus helps in decreasing weight among obese and overweight people if saunf tea or saunf water is taken in the early morning with empty stomach. It helps in preventing from the eye disorders (optic nerves weakness, glaucoma and night blindness) and improving eye sight if carrot juice is taken with half tsf powdered saunf regularly. Regular consumption of saunf helps in maintaining clear vision. Fennel seed promotes blood vessels dilation in the eye by reducing the eye pressure thus prevents from glaucoma (caused due to increased eye pressure), retinopathy (vision loss in diabetics), vision impairment diseases and etc.

It is good source of all the minerals required for bone growth such as calcium, phosphorus, magnesium and etc thus helps in improving bone strength and development. Fennel seed naturally slows down process of bone destroying cells production in the body as well as reduces occurrence of age related bone problems like osteoporosis. Applying the mixture of saunf water (boil two tsf of saunf into a glass of water for at least one hour at low heat) and whey (or dahi water) to the face for 15 to 20 mins then wash, helps in getting fair look with smooth skin. Whether it is applied directly to the skin or eaten, helps in getting acne and spots free skin as it has antiseptic and antioxidant properties.

It slows down the aging process by preventing cell damage and reducing the effects of free radicals thus keeps skin flawless without wrinkles and fine lines. Applying fennel seed water to the skin helps in getting toned, flexible and soft skin as it hydrates the skin by enhancing blood circulation to the face. Regular use of fennel seeds tea (drinking or applying to hair) helps in getting strong and lengthy hair as it prevents unusual hair loss and premature hair graying.

It prevents from hair fall by providing relief from itchy scalp and dandruff. Saunf has emmenagogue property which helps in regulating the regular menstrual flow among women. Its availability with essential phytoestrogens helps in curing menstrual disorders such as premenstrual syndrome, early menopause, unusual breast enlargement and etc. It prevents from the cardiovascular diseases, hormone or estrogen dependent cancer, menopausal disorders, hot flashes, dysmenorrheal (painful menstruation) and etc. Fennel seed keeps mind very calm and stress free by reducing the level of anxiety, depression, stimulating proper menstruation, lowering blood pressure, and etc. It helps in relieving morning sickness, weakness, fatigue and other symptoms during pregnancy. Regular use of fennel seeds helps in improving milk production among women on breast feeding or nursing mothers because of its galactagogue property. Drinking saunf water with little honey (boil saunf into water and add honey) helps in increasing the breast milk production.

It is aphrodisiac in nature helps in enhancing libido as well as maintaining sexual power in both men and women. It is a better home remedy to enhance breast at home than other surgical breast enlargement procedures.

It is loaded with the natural hormones which involve in the developing and growing breast tissues to make breasts large and firm without any side effects. Saunf is used in manufacturing many creams and pills having estrogenic effects which are used by most of the women for years to get their enhanced breast. Its natural phytoestrogens availability prevents abnormal growth of the breast tissues thus protects from breast cancer. Fennel seeds availability with high amount of flavonoids helps in promoting the production of estrogen hormone which in turn promotes breast enlargement. Massaging breast with saunf oil for 10-15 mins each (100-300 circular rubs for each) once a day in the morning or before going to bed helps in enhancing breast size. This procedure needs time and dedication but result oriented. It is very beneficial for the newborn babies as it helps in relieving from the colic pain as well as improving digestion. Massaging joints with the fennel seed oil or saunf oil helps in relieving joints pain (caused due to arthritis) and cellulite. It also provides relieve from the respiratory problems like cough, bronchitis and etc.

It contains essential oil required for the health of liver thus protects from the liver disorders. Drinking jeera and saunf water on daily basis (boil jeera and saunf seeds powder into a glass of water till it remains half) helps in getting wrinkles and acne free skin as well as helps in good digestion by keeping acidity away. Eating one tsf of powdered mixture of saunf, almonds and mishri at every night before going to bed with a glass of warm milk for one and half months helps in improving eyesight by curing all the eye disorders. Avoid drinking water after having this mixture. Taking this mixture with milk also helps in enhancing the memory and concentration level by curing headache and eye pain. Fennel seeds tea is a natural detoxifier (when used regularly) helps in releasing body toxins by detoxifying the body as well as prevents from water retention in the body. It can be prepared at home by boiling one or two tsf saunf seeds or leaves into a cup of water till it remains half and add some sweetener (sugar, honey or jaggery) and milk according to the need and taste. Taking saunf tea on daily basis helps in relieving gastrointestinal disorders including gas, acid reflux, bloating, loss of appetite, indigestion, acidity and etc. Generally it is used by the people during summer season as a home remedy to get relief from the summer heat. It improves digestion by curing intestinal worms problem among kids. It helps in regulating menses by easing menstrual spasms. Regular intake of saunf tea aids in proper digestion and assists in weight loss. It helps in keeping body fit and youth look. It helps in curing bloating, gas, indigestion and digestive tract inflammation which helps in decreasing belly fat and thus weight loss. Fennel leaves are used to reduce the effect of snake bite and neutralize the vegetable poison like mushroom etc. Inhaling the steam of boiled fennel leaves helps in treating respiratory infections of bronchitis and asthma [Taie et al., 2013, Kwon et al., 2002, Zellagui et al., 2011, Yoshioka and Tamada, 2005]

On account of its carminative properties, fennel is chiefly used medicinally with purgatives to allay their side effects and for this purpose forms one of the ingredients of the well-known compound liquorice powder. Fennel water has properties similar to those of anise and dill water: mixed with sodium bicarbonate and syrup, these waters constitute the domestic 'gripe water', used to correct flatulence of infants. Fennel tea, also employed as a carminative, is made by pouring boiling water on a teaspoonful of bruised fennel seeds. In the Indian Subcontinent, fennel seeds are eaten raw, sometimes with some sweetener to improve eyesight.

Extracts of fennel seeds have been shown in animal studies to have a potential use in the treatment of glaucoma, as a diuretic and a potential drug for the treatment of hypertension. It has been used as a galactagogue improving the milk supply of a breast feeding mother. This is suggested to be due to the presence of phytoestrogens present in fennel which promote growth of breast tissue.

NUTRITIONAL BENEFITS OF SAUNF/FENNEL SEEDS PER 100 G

(Source: USDA Nutrient Database)

Energy: 345 Kcal

Carbohydrate: 52.29 g

Protein: 15.80 g

Fat: 14.87 g

Dietary Fibers: 39.8 g

Vitamins

Thiamin (B1): 0.408 mg

Riboflavin (B2): 0.353 mg

Niacin (B3): 6.050 mg

Pyridoxine (B6): 0.470 mg

Vitamin A: 135 IU

Vitamin C: 21 mg

Electrolytes

Sodium: 88 mg

Potassium: 1694 mg

Minerals

Calcium: 1196 mg

Copper: 1.067 mg

Iron: 18.54 mg

Magnesium: 385 mg

Manganese: 6.533 mg

Phosphorus: 487 mg

Zinc: 3.70 mg

CONCLUSION

Foeniculum vulgare has shown that it is an important medicinal plant used in a wide range of ethnomedical treatments, especially for abdominal pains, antiemetic, aperitif, arthritis, cancer, colic in children, conjunctivitis, constipation, depurative, diarrhea, dieresis, emmenagogue, fever, flatulence, gastralgia, gastritis, insomnia, irritable colon, kidney ailments, as a laxative, leucorrhoea, liver pain, mouth ulcer, and stomachache. This plant has been in use for a long period of time without any documented serious adverse effects. Studies carried out in the past and present indicate that fennel possesses diverse health benefits and are an important constituent of food. Studies have shown that various extracts of fennel possess a range of pharmacological actions, such as antiaging, antiallergic, anticolitic, antihirsutism, anti-inflammatory, antimicrobial and antiviral, antimutagenic,

antinociceptive, antipyretic, antispasmodic, antistress, antithrombotic, anxiolytic, apoptotic, cardiovascular, chemomodulatory action, cytoprotection and antitumor, cytotoxicity, diuretic, estrogenic properties, expectorant, galactogenic, gastrointestinal effect, hepatoprotective, human liver cytochrome P450 3A4 inhibitory, hypoglycemic, hypolipidemic, memory-enhancing property, nootropic, and oculohypotensive activity supporting its traditional use. The observed health benefits may be credited to the presence of the various phytochemicals like volatile compounds, flavonoids, phenolic compounds, fatty acids, and amino acids. Fennel also contains mineral and trace elements like aluminum, barium, calcium, cadmium, cobalt, chromium, copper, iron, magnesium, manganese, nickel, lead, strontium, and zinc; fat soluble vitamins such as vitamins A, E, and K; water soluble vitamins like ascorbic acid, thiamine, riboflavin, niacin, and pyridoxine; essential amino acids like leucine, isoleucine, phenylalanine, and tryptophane may contribute to the myriad health beneficial effects at least in part. Among several classes of chemical constituents identified in fennel, volatile components of fennel essential oil and phenolic compounds are assumed to be the main bioactive compounds responsible for the majority of its pharmacological effects. However, the vast traditional use and proven pharmacological activities of fennel indicate that an immense scope still exists for its chemical exploration.

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