

Review Article

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Enlightening Food Application and Mega Health Benefits of *Sesamum indicum* L

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ABSTRACT

From ancient time (over 5000 years) oil crops like Sesame, *Brassica*, *Olea europaea*, etc. have given importance for their nutritional, medicinal and food products properties. One of important oil crop belonging to *Pedaliaceae* family is *Sesamum indicum* L., is an annual plant and being neglected because of many reasons. India and China are the world's largest producers of Sesame, The oil content of Sesame seed varies from 28% to 59%. Sesame oil serve as natural sources of antioxidants i.e. lignans which improves flavor and taste and contributes to greater shelf-life of foods. Sesame seed is rich source of protein. Sesame seeds are used for making flour, breads and cakes. Sesame oil has been used as salad oil and cooking oil. In Ayurveda Sesame is oil is preferred for its medicinal use. Presence of high level PUFAs in Sesame oil reduces blood cholesterol, high blood pressure and plays a central role in preventing atherosclerosis, heart diseases and cancers. The major content of sesamin and sesamolin in Sesame known to have a cholesterol lowering effect in humans and to prevent high blood pressure. Sesame oil sustains high density lipoprotein cholesterol and lower density lipoprotein cholesterol. The antibacterial, Anti-inflammatory, Anti-diabetic and anti fungal actives has been also reported in Sesame seed. Contribution of Sesame is countable in food and health industry because of richness in unsaturated fatty acids, sulfur containing amino acids.

Keywords

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Introduction

Sesame (*Sesamum indicum* L.) belongs to the Family *Pedaliaceae*, it is native to Asian and some African countries (Bedigian, 2003). It is believed that Sesame is one of the oldest crops in the world, cultivated for over 4,300 years in Babylon and Assyria (Hwang, 2005). Sesame is mainly cultivated nationally and internationally for seeds, having 50% oil content. The seed is also used as condiment to

garnish bread and also making halwa as food. It is also used in pharmaceutical and chemical industries (Blal, 2013; Elleuch *et al.*, 2007; Moretto; Alves, 1986; Namiki, 2007). *Sesamum indicum* L is gaining priority as oil seed and also in use as condiment and therapeutics. The potential use of Sesame seed oil in health and food has been documented for centuries. Sesame oil is known since vedic times and is the most honored oil in Ayurveda. In Ayurvedic

medicine it has much significance and practitioners believe that Sesame oil has antibacterial and antifungal properties. In Ayurveda, Sesame is known to cure Tridoshas during massage, the oil is rubbed on the skin to improve energy flow and help free the body from impurities. In Ayurveda, Sesame oil is used as an anti-bacterial mouthwash and it can also use in treatment of relieve anxiety and insomnia. Premenstrual syndrome (PMS) can be treated by applying the oil on to the abdomen region. Sesame is known to cure bleeding dysentery, burns, ear pain, headache and impotency. Sesame has a reputation as a healing medicine and sedative in Tibetan medicine and also used for millennia in China as medicine.

Holistic medicine practitioners use Sesame seed oil to treat strep throat, staphylococcus bacteria and also athlete's foot. Sesame oil is believed to relieve pain syndromes such as tendonitis, bursitis, arthritis, colitis, irritable bowel syndrome and Gastroesophageal Reflux Disease (GERD). It can also reduce stress, lower cholesterol and detoxify the body. The rich magnesium content of Sesame seeds can be helpful for those suffering respiratory problems, zinc and calcium in Sesame seeds is a powerful tool to help combat osteoporosis. Sesame seeds contain sesamol, an important antioxidant and anti-inflammatory compound, known to be beneficial in battling heart disease and atherosclerosis. Sesame oil contains significantly more polyunsaturated fats, which include omega-3 fatty acids. These beneficial fats help protect your heart from damage, regulate your blood pressure and might reduce your risk of type 2 diabetes. Sesame has been regarded in the orient as a health food for energy increase and aging prevention (Hajimahmoodi *et al.*, 2008). Sesame oil compounds have multiple physiological functions, such as estrogenic activity, providing anti-inflammatory functions,

decreasing blood lipids and arachidonic acid levels (Hirata *et al.*, 1996; Kita *et al.*, 1998). Compared to major oilseed crops such as soybean (25%), rapeseed-canola (20 -26%), sunflower (30%) and cotton (35-40%) the oil content of Sesame varies from 28% to 59%.. Black Sesame contains less oil as compared to white and brown variety. In general, the cultivated seed has around 50% oil as compared to wild variety (30%), Slight influence on the oil content has been seen due to color of seed, the oil content plays important role in seed selection in agriculture practice. The oil content was found to be influenced by the growing condition, daily mean temperature, and the cumulative degrees of daily temperatures during reproductive stage, which showed negative correlation with the oil content (Hu *et al.*, 2004).

Cultivation and production

Sesame is a tropical herbaceous annual plant with height up to 2 m, with an unpleasant odor. The leaves vary from ovate to lanceolate and are hairy on both sides. The flowers are varied in colour with purple to whitish, resembling foxglove, followed by nearly 3 cm capsules/fruits containing numerous seeds (McCormick, 2001). The number of fruits ranges from 15-20 that can have 70-100 seeds. Sesame matures in 80–180 days when the stems are cut and hung upside down for the ripe seeds to fall out to be collected on mats. Cultivation of Sesame is grown for its seeds that are rich in oil that can have valuable uses. The young leaves can be used for eating in stews and the dried plant may be burnt as fuel for source of energy. Sesame seeds are used for oil extraction directly, and rest is used as meal, paste, confections and bakery products (Salunkhe *et al.*, 1991). After harvesting, the seeds are cleaned and dried to about 8% moisture and then stored before crushing. To improve

quality removing the seed coat, dehulling is done before crushing (Morris, 2002). In India, where Sesame meal is a valuable meal, this process is performed in oil extraction plant. balance to health food products (Prakash, 1985; Quasem *et al.*, 2009).

Sesame has many species, and most are wild. Most wild species of the genus *Sesamum* are native to sub-Saharan Africa. *Sesame indicum* L the cultivated type, originated in India. Charred remains of Sesame recovered from archeological excavations have been dated to 3500-3050 BC. Although, Sesame has been cultivated in the Harappan, Mesopotamian, and Anatolian eras for over 5000 years, it was first cultivated and domesticated in India (Bedigian, 2003). In Africa, Sesame is a fundamental source of protein and there are many wild types. Sesame has also been dispersed to many places in the world. Currently, Sesame is grown in tropical and subtropical areas (Ashri, 1998). According to FAO (Food and Agriculture Organization) more than 7 million hectares are used for Sesame production in the world and every year approximately 3.5 million tons of product is obtained. India, Myanmar and China are the top producers, respectively. Like other plant crops, Sesame is susceptible to biotic and abiotic stresses such as diseases, pests, and drought (Bhat *et al.*, 1999). Despite the fact that Sesame is a cultivated plant, the shattering and indeterminate growth traits of Sesame are like wild type. In addition to these wild type aspects, lack of improved cultivars, susceptibility to diseases, pests and environmental stresses lead to low yield in Sesame cultivation.

Composition of sesame oil

Sesame seed is an important source of oil (44-58%), proteins (18-25%), carbohydrates (~13.5%) and ashes (~5%). Sesame oil has a remarkable stability to oxidation attributed to

endogenous antioxidants like lignins and tocopherols (Elleuch *et al.*, 2007; Lee *et al.*, 2008). Oxidative stability of Sesame oil is higher (due to endogenous antioxidants (lignans) together with tocopherols) in case of the oil extracted from coated seeds than in that extracted from dehulled seeds (because of less tocopherol and total phenolic compounds) (Abou-Gharbia *et al.*, 1997; Elleuch *et al.*, 2007). In general Sesame oil contains fatty acid that varies considerably among the different cultivars worldwide. It has saturated fatty acid about 16.5% and mono unsaturated fatty acid nearly 44% and polyunsaturated fatty acid 41.5%, oleic (35.9-47%), linoleic (35.6-47.6), palmitic (8.67-13%) and stearic (2.1-6.4%) acids with small arachidic acid (0.8%) Thus, Sesame oil belongs to the oleic-linoleic acid group. It is reported that linoleic acid is the most significant polyunsaturated fatty acids in human diet with ability to prevent heart vascular diseases.

Fatty acid and oil content are influenced by various physiological, ecological and environmental factors (Uzun *et al.*, 2002). Sesame oil is relatively high in unsaponifiable matter (2%) sterols of this with major 85.55% of demethylated, triterpenes and triterpene alcohols, tocopherols, and Sesame lignans. Demethylated sterol is the major one (85-89% of total sterols). The tocopherol content of Sesame oil ranges from 330-mg/kg to 1010-mg/kg oil according to the Codex Standard. It is surprising to know that the most prominent health benefits of sesame oil are attributed not to the major omega – 6 fatty acid (linoleic acid), but to the three sesame specific nutrients – sesamin, sesamol and sesamin. This asserts that even the micro-nutrients found in trace amounts can hold the key to the strongest and most powerful medicinal effects of foods. Besides fats, sesame oil is also rich in Vitamin E, which is a good anti-oxidant. Vitamin E, being good

for normal growth, development, skin and immunity, Niacin is another B-complex vitamin found abundantly in sesame.

Nutritional profile of sesame

Sesame oil, known as queen of oils is a constituent of varieties of food and highly stable at high temperature and seldom turns stale in hot climate. It has good percentage of unsaturated fatty acids, the fatty acids composition is 14% saturated, 39% mono-unsaturated, and 46% poly-unsaturated fatty acids. Carbohydrates present in Sesame seed are 3.2% glucose, 2.6% fructose and 0.2% sucrose (Table 1).

The protein globulin in Sesame contains about 95% of 13S globulin and seems to be a major protein, very susceptible to heat denaturation and similar in subunit structure to soybean 11S globulin but having higher hydrophobic properties. Sesame is rich in sulfur containing amino acids and poor in lysine and contains significant amounts of oxalic (2.5%) and phytic (5%) acids (Kapadia *et al.*, 2002). Decorticated Sesame seeds have 45-63% oil, 19-31% (averaging about 25%) proteins, about 14% carbohydrates and about 3% ash. Unlike many oilseeds like, Sesame meal is devoid of anti-tryptic compounds. Sesame oil is rich in polyunsaturated fat that area used in margarine production and cooking oils. Sesame seeds contain two unique substances, sesamin and sesamol having a cholesterol lowering effect in humans and to prevent high blood pressure. Both of these also known to increase the hepatic mitochondrial and the peroxisomal fatty acid oxidation rate. The meal known for its high protein content, which is rich in methionine and tryptophan, which makes Sesame meal best for health because methionone and tryptophan is missing a number of other vegetable proteins.

Medicinal properties of Sesame seeds and health issues

In recent years it has been imperative to know the food components that lower or regulate cholesterol levels. Lipid metabolism through a series of biochemical actions in both humans and animals are controlled by lignan sesamin. Dietary sesamin and episesamin influences considerable increase in the gene expression of mitochondrial and peroxisomal fatty acid oxidation enzymes such as carnitine palmitoyl transferase, acyl-CoA dehydrogenase, acyl-CoA oxidase, 3-hydroxyacyl-CoA dehydrogenase, enoyl-CoA hydratase, and 3-ketoacyl-CoA thiolase which may leads to increase the hepatic activity of fatty acid oxidation which is due to enhanced ketone body production. Alpha-tocopherol to a great extent accentuates the hypocholesterolemic action of sesamin. Sesamin protects the liver from oxidative damage. The oil has been used from ancient time for healing wounds. It is antibacterial and antifungal for common skin pathogens such as *Staphylococcus* and *Streptococcus* and athlete's foot fungus. It is anti-viral and anti-inflammatory.

In Ayurveda the oil has been used in the treatment of several chronic diseases including hepatitis, diabetes and migraines. Analgesic activity of *Sesamum indicum* has been tested by acetic acid-induced writhing model in mice by Nahar and Rokonzaman (2009). Acetic acid causes algnesia by liberation of endogenous substances, which then excite the pain nerve endings (Raj, 1996). Sesame oil has inhibitory effect on the growth of malignant melanoma *in vitro* and the proliferation of human colon cancer cells (Smith and Salerno, 1992). Sesame oil neutralizes oxygen radicals beneath. It penetrates into the skin quickly and enters the blood stream through the capillaries.

Sesamin increasing the fat oxidation and decreases lipogenesis by decreasing lipogenic enzymes of liver. Sesamin has been shown to increase the production of ketone bodies. when fatty acid oxidation is increased to a point where the liver cannot metabolize all the fatty acids for energy ketogenesis occurs. Excess acetyl-CoA is converted to ketone bodies in the liver and released into the blood-stream for use by other tissues especially the brain. Ketogenesis plays a critical role during low carbohydrate diets because during low carbohydrate the brain uses only glucose as fuel and when glucose is low, the brain will utilize ketone bodies for its energy.

Nutraceuticals and pharmaceutical uses of Sesame

Sesame milk can be prepared using decorticated Sesame seeds, that can be a analogues, which can be confirmed as health foods that can be used as dairy substitutes or extenders (Jihad *et al.*, 2009). Sesame lignans have antioxidant and health promoting

activities (Nakai *et al.*, 2003). Sesame seed taken in diet increases plasma γ -tocopherol and enhances vitamin E activity which helps to prevent cancer and heart diseases (Cooney *et al.*, 2001). Sesamin is heat stable and remains at 90% of the original level after roasting (Abe *et al.*, 2001) indicating its viability for food and non-food applications. The total phenolic content (TPC), Trolox equivalent antioxidant capacity assay, free radical scavenging capacity, inhibition of low density lipoprotein (LDL) cholesterol and metal chelating capacity of extracts of whole black and whole white Sesame seeds and their hull fractions in 80% aqueous ethanol considerable shows antioxidant activity of Sesame products tested especially black Sesame hulls (Shahidi *et al.*, 2006).

Myristic acid found in Sesame seed has cancer preventive capability. Sesame oil is used as a solvent for intramuscular and has nutritive, demulcent, and emollient properties and has been used as a laxative.

Table.1 Sesame as food

Food	Country
Sesame cakes, wine, and brandy	Biblical Babylon
Bread stick, cracker, Salad and cooking oil	Worldwide
Roasted seed	India
Substitute for olive oil	Europe
On bread	Sicily
Cakes	Greece
Soup, spice, seed oil	Africa
Salad and fish oil	Japan
Confectionery	China
Sesame seed buns, chips	United States

Source: Food, Industrial, Nutraceutical, and Pharmaceutical Uses of Sesame Genetic Resources J. Bradley Morris

Sesame oil is used in pharmaceutical aid as a solvent for intramuscular injections. The oil has been used from the 4th century by the

Chinese as medicine for toothaches and gum disease. In recent time Sesame oil is significantly being used for treating nasal

mucosa dryness due to a dry winter climate. In addition, Sesame oil contains large amounts of linoleate in triglyceride form which selectively inhibited malignant melanoma growth (Smith and Salerno 2001).

Food and industrial uses of sesame

There are many foods with Sesame as a component. Europeans use it as a substitute for olive oil. Sesame oil is an excellent salad oil in Japanese diet for cooking fish. The seeds are also used on bread and then eaten in Sicily. Cakes are made by Greece from Sesame oil, while in Africa the seeds are used as soup flavor enhancing ingredient. Hulled Sesame seed enriches bakery and candles and is also the base for the creamy, sweet wholesome tahini. Sesame seeds contain three times more calcium than a comparable measure of milk. Today, energy demand is increasing while world fossil energy resources are increasingly depleted. The vegetable oil is potentially able to replace mineral oil in future.

Future aspects of sesame

Sesame is easy to grow and well suited for cultivation in crop rotation. This plant is one of the plants where the oil content in seed is high. This produce is not only in use for culinary purposes, but also in various applications such as industrial, engineering, and pharmaceutical. The ethno-botanical and medicinal uses of this commercially important, nutritionally rich oilseed need to be explored for better utilization. Sesamin possess the capacity to increase the fat burning process and decrease the storage of fat in the body by modifying the gene expression of the fatty acid oxidation enzymes. It has potential application in the development of nutraceuticals for weight reduction.

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