

An Overview: Chia Seed, Chia Seed Oil, Applications and Its Benefits.

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Introduction

In recent times, health awareness is increasing day by day throughout the world; it demands for functional food with multiple health benefits. The use of medicinal food to prevent diseases is gaining momentum around the globe.

Chia is popularly re-introduced into Western diets because of its multiple positive nutritional properties. The word “chia” is derived from Nahuatl- *chian*, meaning Oily; also known as *Salvia hispanica*. It is cultivated in several countries of Western South America, Western Mexico and South Western United States. Today, its cultivation is extended to the other areas of Australia and Southern Asia (Jamboonsri et al., 2012). It is considered as Pseudocereal and is well known for its nutraceutical value.

Great potential for chia is seen as future crop plant. Chia requires less water than cereals or other oil seeds to grow, so it is also investigated as future crop for more diversity in Argentina and the U.S. (Coates and Ayerza, 1996, 1998; Estilai et al., 1996; Gentry et al., 1990). As new ω -3 fatty acid source the flowering of chia was successful applied in the growing season 2009 in Kentucky for example (Jamboonsri et al., 2011). Chia is also an interesting forage crop in Greek (Bilalis et al., 2016) and the mediterranean and desert climates of Chile (Baginsky et al., 2016; Cortés et al., 2017). Recent studies showed, that water stress leads to an increase of lipid and therefore ω -3 fatty acid production (Silva et al., 2016; V. Zettel et al., 2018). Chia seed is considered as a Dietic Nutritional Supplement by the Food & Drug Administration in the United States and qualifies as “healthy food” by NSRI’s standards (Motis Tim 2011). Nowadays, chia seed is treated as a newly discovered superfood. It has a long history of food crop and now it is re-valued for its nutritional value and health benefits. CSIR-Central Food Technological Research Institute (CFTRI) Mysore, Karnataka began their research work on chia seed in 2012 and introduced the crop to Indian farmers for cultivation for the first time (Police Patil et al., 2020).

Importance of Chia Seed:

Chia has been used for various purposes, both for the consumption of humans and as animal feed, also it is used commercially. It carries multiple forms suiting the particular application. Chia seed products are used popularly for consumption purposes like, as pure oil or oil added in food, protein isolates, protein hydrolysates and chia mucilage for fibre (HRNCIC et al., 2020). Composition of chia seed is presented to be fibre dietary fibre,(18-30%), ash (4-5%), protein (15-25%), fats (30-33%), lipids (31-35%), carbohydrates (26-41%), minerals, vitamins and also contains a high proportion of antioxidants like caffeic acid, quercetin, etc. (Ixtaina et al., 2008).

Overall, *Salvia hispanica* seeds are an incredible source of nutrients and also have an enormous potential as a nutraceutical attracting great interest in medicinal science. Most interestingly it is gluten free, which makes it more appealing when it comes to addition in various food products. The commercial production of this old and at the same time new oilseed as an alternative crop is an economical attraction to the food formulation as well as the farmers in order to make the most of its viability as a functional food. Adding to its greatness, the bioactive components present in chia seed ensures its potential to rise as a nutraceutical/health supplement to provide various health benefits but it is essential to validate the efficacy and safety with new in vivo and clinical studies (Loreto A. Munoz et al., 2013).

Health Benefits of Chia Seed:

Chia seed can maintain a balanced serum lipid profile, although more research is needed to be done on the safety and efficacy of its use as a dietary supplement as well as prevention and treatment on human diseases. Several authors like (Toscano et al., 2014; Vuksan et al., 2010; Salgado-Cruz et al., 2014) have reported positive effects of chia consumption on human health. Chia has been suggested as a supplement in conventional therapy for overweight and obesity in diabetes. Jenkins et al., 2016 suggested after a double blinded, parallel and randomized study that, high dietary fibre content of chia promotes weight loss through glycemic control. It is found to that chia seed affect satiety and is beneficial in the treatment of overweight and obese patient with Type 2 diabetes (V. Zettel et al., 2018). Health promoting properties and applications of chia. Albert et al., 2005 promotes the hypothesis that Omega-3 fatty acid through increasing intake of α -linolenic acid might

reduce the risk of sudden cardiac arrest causing death. In addition, chia seed is rich in vitamins such as riboflavin, niacin, and thiamine compared to the other seeds. The concentration of calcium is higher in chia seed than found in milk as well as iron which promotes bone and liver health (Ullah et al., 2016). The consumption of chia showed on iron bioavailability similar to ferrous sulphate (da Silva et al., 2016).

Chia seed is known for its antioxidants which can inhibit the activation of NF- κ B transcription factor *in-vitro* thus, reducing inflammation and carcinogenic processes. Furthermore, the antioxidant action can protect the organisms from neurological diseases, inflammatory disorders, immunodeficiencies, ischemic heart disease, strokes, Alzheimer's and Parkinson's disease and cancer (Marcinek&Krejpcio., 2017). Additionally, chia seeds have found to show a hypotensive effect by enzymatic analysis. The chia protein hydrolysate has blocking activity of angiotensin-converting enzyme. In an animal study, both chia seed and chia flour (heat-treated / untreated), reduced plasma glucose in Wistar rats after 14 days of treatment (da Silva et al., 2016). The study concluded, that the consumption of chia seed improved glucose and insulin tolerance for both prevention and treatment in the groups of rats.

Chia Seed Oil:

Chia seed consists of about 28-32% oil which happens to be rich in polyunsaturated fatty acid especially Omega-3 (linolenic acid~68%), more than any other known plant source and also Omega-6 (linoleic acid~19%) (FERNANDES et al., 2019). Moreover, other valuable components can also be found in chia oil such as- tocopherol, polyphenol, phytosterols, carotenoids and phospholipids (JULIO et al., 2019).

Chia oil like other vegetable oils, doesn't contain Cholesterol which makes it advantageous over other food products containing essential fatty acids like fatty fish which contains a significant amount cholesterol. It has low sodium content compared to other sources of Omega-3 fatty acid, making it an excellent food choice for people suffering from Hypertension (BUSILACCHI et al., 2013). Chia oil has ranked to be superior in quality parameters than other oils such as Soybean oil, Sunflower oil, Rapeseed oil and Olive oil. It is most sustainable and cheapest source of PUFA Omega-3 and intake of 25-50g per day is enough to meet the daily demand (Vuksan et al., 2007).



Fig 1. Chia seed and Chia seed oil.

Benefits of Chia Oil Consumption:

Previously, many studies have been performed on chia seed to demonstrate the beneficial effect on health mainly pointing their focus towards the nutritional quality and beneficial of the oil present in the chia seed (ENES et al., 2020).

It has been shown in recent researchers that the supplementation of 50g of chia seed per day increases the plasma linolenic acid content, significantly but doesn't help with reducing weight in obese (NIEMAN et al., 2009). Although, daily dietary intake of 35-37g of chia seed can control hyperglycemia in diabetics and also reduce systolic blood pressure (TOSCANO et al., 2014; VUKSAN et al., 2007). According to (JIN et al., 2012) in healthy postmenopausal woman, the ingestion of 25g of oil can increase the level of Eicosapentanoic acid (EPA) and plasma linolenic acid. Intake of 7kcal kg⁻¹ of pure chia seed oil by athletes about 30 mins prior to running resulted in giving a 3.4-fold increase in the α -linolenic plasma levels but did not affect their performance in any way (NIEMAN et al., 2015).

The increase in levels of plasma-linolenic acid hold an important significance as it aids the performance of cell membrane, brain functions, nerve impulse transmission and most importantly the transfer of oxygen to blood plasma; hemoglobin synthesis and cell division. Increase in the level of Eicosapentanoic acid contributes to preventing inflammatory disorders, allergic reaction and cardiovascular complications and diseases (KAUR; GAUR; GUPTA, 2014).



Chia seed oil is known to have a high polyunsaturated fatty acid/saturated fatty acid ratio (PUFA/SFA); making it one of the highly favorable oils which helps in reducing serum cholesterol and atherosclerosis, also acts in the prevention of cardiovascular diseases. As obtained by (SHEN et al., 2018) the ratio of PUFA/SFA in chia oil is 8.85 and with this it is suggested to incorporate chia seed oil in the daily diet which could bring out great beneficial effects towards the cardiovascular system as it contains high amount of PUFAs.

Bioactive potential of chia seed oil can help in reducing risk of chronic diseases due to antioxidants, anti-inflammatory, hypoglycemic and hypolipemic effect when acquired in regular use. Although, clinical trials are to be made regarding the safety of dosage and side effects; mechanism of action of biomolecules to recommend appropriate use chia oil products. Chia seed oil and chia seed have different potentials as antioxidants stated by in vitro assay (MARINELI et al., 2019). It is verified that daily consumption of chia oil improves antioxidant and plasma status of liver and reduces peroxidation of plasma lipid; also has a protective effect against oxidative stress in obese.

Anti-inflammatory property of chia seed oil examined by (Gazem et al., 2016) and its synergy with other vegetable oils employs in vitro systems. Anti-inflammatory activities increase with increase in the dosage of chia oil concentration. Chia seed oil contains high number of antioxidants which have the potential to preform protection against many other diseases and they are- tocopherol, phytosterols, carotenoids and phenolic compounds (IXTAINA et al., 2011). This oil could also work as an alternative source for Omega-3 fatty acid for vegetarians or people with fish allergies since nothing particularly has been found in both the seed and oil which cause problem related to nutritional health and digestive system. WAT (white adipose tissues) plays a vital role when it comes to endocrine health and metabolic function by participating in energy regulation hemostasis and insulin sensitivity. Relatively it has been recently verified by (Souza et al., 2020), that chia oil supplementation induces browning process in Swiss males which is beneficial to health referring to subcutaneous WAT in the onset of obesity.

Chia Seed/Oil Used in Food Application:

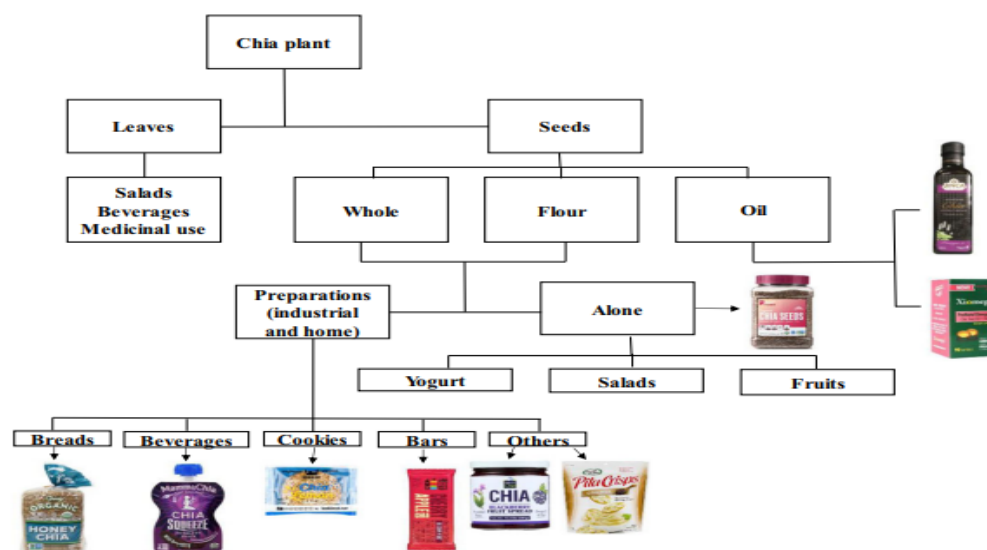


Fig 2: Uses of Chia seeds in different products.

Chia is used in various different application regarding food industry and has been a popular food material in recent times. It is used in many forms, few of which are- chia seed, chia oil, chia flour or ground chia, chia mucilage, etc. according to its requirement mentioned below;

- **Baking goods:** To prepare baking goods like pound cake or bread, ground chia is used as an additive to improves the quality of the product. Chia is used in bakery as whole seed, ground chia or chia flour, soaked or dry. The basic aim of adding chia is to improve the nutritional composition of baked goods. The application of fat is also reduced by using chia mucilage gel in pound cake. Also, the replacement of egg with chia gel has resulted in forming more nutritious product with more appreciable and acceptable sensory aspects. Addition of chia flour significantly increases water absorption in dough.
- **Meat & Fish products:** Fortification of meat products are also done with chia seeds; improving nutritional, sensory properties and also physicochemical aspects of restructured ham-like meat products (Ding et al., 2017). Low fat burgers are prepared using chia oil as a substitute; Although quality suffers but hardness is not affected; fat retention and cooking loss is improved (Heck et al., 2017). Some studies also incorporated chia flour in fish products for nutritional improvement of products (Carbonera et al., 2016).

- **Gluten-free products:** As we know, chia seeds are gluten-free and its flour is especially used in making gluten-free products like bread; The nutritional quality is generally low, when it comes to gluten-free bread. Constantine et al., (2014) advised for substituting 10% buckwheat flour with chia flour in gluten-free bread. It was identified that increase in moisture, fat and dietary fibre took place but there was no significant change in specific volume, also carbohydrate content decreased. Although amount of linolenic and linoleic acid increased. Furthermore, gluten-free pasta based on rice flour was optimized with chia flour and mucilage as thickener to increase nutritional value (Menga et al., 2017).
- **Dairy Products:** The application of chia in dairy products has increased lately. Chia mucilage is used as a thickener in ice cream. Chia seeds are used as an appealing food material in Yoghurt, as a mid-morning snack, providing satiety to the diet. 6% of chia flour is added in Indian traditional dairy-based sweets, facilitating it with appreciable sensory characteristics.

Conclusion

This review presents the references of some studies involving chia seed and chia seed oil, its origin and health benefits that can be proven to enhance the knowledge about this super food with incredible potential. These proven benefits show us that this relatively new oil has great potential for consumptional and production benefits. Many investigating which demonstrate the mechanism action of bioactive compounds present in chia seeds are still inconclusive. Although, the application of chia seed has gained a lot of popularity in the improvement of nutritional value but chia consumption on human health needs more research for safety evaluation. The nutritional and functional improvement of products using chia in its forms is a very promising approach.

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