

# The Role of Chia Seeds Oil in Human Health: A Critical Review

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## ABSTRACT

Chia, *Salvia hispanica* L., is emerging as an important functional food ingredient because of its rich contents of dietary fiber, omega-3 fatty acids and an indicative source of bioactive peptides owing to its high concentration of proteins and essential amino acids. The use of food with nutraceutical and functional properties for management of lifestyle diseases like diabetes, obesity, and cardiovascular problems is now gaining momentum among the public. Current research findings reveal high nutritive value for chia seeds and their oils validating their massive health-promoting properties. Currently chia is consumed as seeds and oil with similar effects. The oil is rich in polyunsaturated fatty acid,  $\alpha$ -linoleic acid, the biological precursor to docosahexaenoic acid and eicosapentaenoic acid. It has been scientifically established that chia is an immune improver and has therapeutic effects on control of diabetes, dyslipidemia, hypertension, as anti-inflammatory, antioxidant, anti-blood clotting, laxative, antidepressant, antianxiety, analgesic and vision. This article provides a review of the role of chia seeds oil in human health. The Phytochemical characteristics of chia oil is presented and the effect of their consumption on human health is discussed.

**Keywords:** Chia seeds oil, polyunsaturated fatty acids, omega-3, health-promoting properties.

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## I. INTRODUCTION

*Salvia hispanica* popularly known as chia is an ancient seed which was popular among the Aztecs in Mexico. Chia plant is an herbaceous vascular in appearance and is classified under kingdom plantae [1]. A study conducted by da Silva et al. [2] found that Chia seeds are composed of an oil content of 30.21 g/100 g, proteins 25.32/100 g proteins, a dietary fiber of 37.5 g/100 g and major insoluble fiber of 35.06 g/100 g, which reveals the contribution of chia seeds to human nutrition as functional food. In the world today, chia has a great potential in health industry, pharmaceuticals, nutraceutical, food industry among others, and can be utilized as seeds or as oil and still give similar benefits. Chia has also been identified as a product with a collection of possible health benefits that leverage some detriments such as cardiovascular ailments, obesity, diabetes, low cognitive performance, high levels of cholesterol, and bowel function regulation [3]. Chia seeds are used as a food commodity while chia oil is used as a dietary supplement [4].

According to Parker et al. [3] chia oil is extracted from seeds by means of cold pressing excluding use of both solvents and exterior heat in the process of oil extraction. Chia oil being high in poly unsaturated fatty acids are susceptible to oxidation which can lead to a decrease in nutritional and sensory quality. Cold oil press is carried out by pressing chia seeds using a double screw extruder, with temperatures kept below 50 °C, in order to inhibit oxidative

stress that will cause a change in unsaturated fats. The oil extracted has sludge and therefore passed through a plate filter to remove the sediment and to polish the oil.

## II. NUTRITIONAL COMPOSITION OF CHIA SEEDS OIL

Chia seeds contain up to 39% fat with an extremely extreme portion (44–69%) of  $\alpha$ -linolenic [5] is rich in protein (up to 25%) and crude fiber (up to 30%), that qualify them as a rich source of omega 3 fatty acids and dietary fiber [6]. Chia seeds oil is rich in polyunsaturated fatty acid precisely omega 3 linoleic acid, approximated to be between 55%-66% and omega 6 -linoleic acid of between 13%-23% [7], [8]. Of the total mass of the seed, the polyunsaturated component is approximated to be 26.85%, monounsaturated being 1.88%, and the saturated fats making up to 2.91%. Research as shown that a high concentration of omega-3 fatty acids in the diet is correlated with a lower risk of autoimmune disorders, cancer coronary artery disease, hypertension, rheumatoid arthritis and type 2 diabetes [9]). Various researchers have analyzed and compared the fatty acids profile for chia seeds against other similar seeds such as flax seeds.

Chia seeds oil is becoming an appealing and preferred choice for healthy food and cosmetic applications due to its adequate concentration of linoleic fatty acids (55–60 %) and linoleic acids (18–20 %); and lower content of saturated fatty acids (palmitic and stearic acids) and [5]. Both chia seeds and the oil have been safely applied in animal feeds to decrease the cholesterol levels and increase the polyunsaturated fatty

acids and in egg and meat and products [10]. Presently, more research is being done on sources of alpha linoleic acids due to the recurrent mercury contamination of fish supply and depletion of ocean fisheries, that has led to reduced intake of the long-chain n-3 fatty acids found in fish have been associated with reduced risks of coronary heart disease [11]–[13]. There is also high market interest in chia due to the superior, significant chemical composition of the seeds. Chia seeds and oil contain a catalogue of health benefits owing to the fact that it contains high number of antioxidants. Chia has been beneficial in cardiovascular diseases, diabetes, obesity and reduction of blood pressure and cholesterol among others.

### III. HEALTH BENEFITS OF CHIA

#### A. Chia Seeds and Cardiovascular Diseases

Alpha-linoleic acid and eicosapentaenoic acids are essential in forming vital biochemical compounds like thromboxane, leukotrienes, and prostaglandins which are utilized in various physiological functions in the body [14], [15] Omega 3 fatty acids are capable of blocking the dysfunctions of sodium and calcium channels which else can lead to hypertension [16], [17]. In addition, Watanabe & Tatsuno [16] further postulates that omega-3 fatty acids enhances the heart rate variability, guard ventricular arrhythmia, and parasympathetic tone. Chia seeds being a rich source of omega 3 makes it a good product to be used in protecting the body against cardiovascular disease. A review study conducted by Ullah, et al. [8] on the nutritional and therapeutic perspectives of chia found out that chia is a great source of antioxidants. Having components such as quercetin, acid, kaempferol and myricetin which are believed some benefits such as hepatic and cardiac protective effects, anti-carcinogenic and anti-ageing traits.

In a study to evaluate the antihypertensive and ant oxidative effects of functional foods containing Chia, Salazar-Vega et al. [18] used chia from Mexico in the study. The results of the study revealed that chia seeds protein hydrolysates had an inhibitory impact on angiotensin converting enzyme. The results suggest that chia performs as an electron donor and as a scavenger for free radicals thereby providing an antioxidant protection that may decode antihypertensive action.

#### B. Chia Seed Oils and Obesity

There have been several studies that have been undertaken to find out the relationship between chia seeds oil and obesity. da Silva Marineli et al. [2] conducted a study aimed at investigating the effects of chia seeds and chia seed oil on heat shock proteins and associated restrictions in obese rats. In this study, the researchers divided the animals in six groups. These groups were: high fat and high fructose diet, control, high fat and high fructose diet with chia seeds or chia oil one for 6 weeks and the other for 12 weeks. With a significance level of  $P < 0.05$ , the following were determined: Plasma indicators for liver damage and glucose tolerance, proteins regulating oxidative energy metabolism, and skeletal muscle for antioxidant enzymes. The results of the study revealed that the high fat and fructose diet prompted intolerance to glucose, resistance to insulin, oxidative stress,

and the changed variables related to obesity. Gain of body weight and abdominal fat accumulation was not reduced by consumption of either chia seeds or chia oil. Nonetheless, in the two treatments, chia seed and chia oil enhanced insulin and glucose tolerance. HSP70 and HSP25 expression is induced by chia oil in skeletal muscle. Besides, chia oil reestablishes system expression altered by high fructose and fat diet. Proliferator stimulated Receptor- $\gamma$  coactivator-1 $\alpha$  expression abridged by high fat and fructose diet is also reestablished by chia oil and chia seeds. The expression of tissue protection proteins is also enhanced by chia seeds and oil. There is a higher antioxidant system reestablishment and an induced countenance of greater number of proteins in chia oil as compared to chia seeds [2], [17].

A study conducted by Mohamed, Mohamed & Fouda [19] on the anti-inflammatory potential of chia seeds and chia oil focusing on arthritis merged with obesity. As a natural source of antioxidants, chia prevents oxidative stress mediated diseases. The study was evaluating the validating chia oil and mucilage obtained from chia seeds as anti-inflammatory nutraceutical. 48 male Sprague-Dawley rats were used in this research. After 8 weeks of feeding the rats with high fat and sugar diet, obesity was developed in these rats. At the beginning of week 9, chia oil and chia mucilage were administered for a duration of 21 days. Arthritis was also induced by use of an injection in both obese and non-obese rats. Afterwards, swelling of the paw was then determined. Other factors that were determined include: kidney and liver functions, plasma tumor necrosis factor, erythrocyte catalase, lipid profile, and serum lipid peroxidation. The results of the study revealed that obesity with arthritis led to oxidative stress, swelling of the paw, plasma tumor necrosis factor and dyslipidemia. However, chia oil showed an improvements of the defects and therefore the conclusion that chia oil and mucilage has anti-inflammatory effect on arthritis and obesity.

#### C. Chia Seed Oils and Diabetes

There have been several studies conducted to evaluate the effect of using chia seeds and chia oil on diabetes treatment. Most of these studies are animal trials. A research conducted by [20], [21] aimed at finding out the effect of chia seed oil on composition of the body and insulin signaling and in muscles of obese rats. The researchers used mice and fed them with high fat diet for 135 days. The mice were then divided into groups and one group was fed with chia oil from 90<sup>th</sup> day to day 135. The findings were that consuming chia oil decreased accumulation of fat mass and enhanced lean mass. Besides, obese mice fed with chia oil exhibited greater tyrosine phosphorylation of insulin receptor substrate 1, more translocation of glucose transporter type 4 and higher activation of protein kinase B. Supplementation with chia oil enhances insulin tolerance and glucose level, reduced serum insulin and triacylglycerol, and improved blood lipoprotein cholesterol levels. Findings of Chicco et al. [22] study on benefit of consuming  $\alpha$ -linoleic acid rich chia seeds upon insulin resistance and dyslipidemia, postulated that dietetic chia seed barred the inception of dyslipidemia and insulin resistance in the rats fed with high sucrose diet. Besides, chia seeds reduced visceral adiposity that was in the rats.

#### D. Chia Seed Oils and Renal Disease

Various studies have been carried out to determine the efficacy of dietary omega 3 fatty acids with renal defects. While most patients suffering from end renal stage disease complain of xerosis and pruritus, there are claims that omega 3 fatty acids help to leverage these effects. Jeong [23] conducted a study to evaluate those claims. Using five healthy volunteers with symptoms of xerotic pruritus and other five patients suffering pruritus the researchers applied chia seed oil on them for a period of 8 weeks. Itching symptoms and other skin conditions such as water loss and skin capacitance were assessed. The results of the study were that there was an improvement in lichen simplex, skin hydration and prurigo nodularis among all patients. There was also an improvement of the of epidermal penetrability hurdle function and skin hydration. From the study we can conclude that chia seed oil can be utilized as a moisturizing agent for pruritic skin patient [24].

#### E. Chia Seed Oils and Cancer

Bioactive compounds obtained from plants can have been considered to contain anti-cancer and chemo preventive compounds [25]. Vara-Messler et al. [26] conducted a study aimed at determining whether  $\alpha$ -linoleic acid enriched diet have an impact on growth limits when applied to a syngeneic model of mammary carcinoma. Chia oil diet rich in  $\alpha$ -linoleic acid and corn oil diet was fed in mice which were subcutaneously injected with a tumor cell. Tumor incidence, metastasis number, weight and volume were seen to be lower in mice fed with  $\alpha$ -linoleic acid. However, tumor latency time was greater and release of pro-tumor metabolites that were obtained from omega 6 fatty acids reduced in the tumor. It was also observed that in comparison to the control experiment, there was a lesser amount of mitosis. An  $\alpha$ -linoleic diet was observed to reduce the estrogen receptor a known promotor of breast cancer. The data from the study concluded that there is anticancer effect of diets enriched with  $\alpha$ -linoleic can be used to prevent breast cancer.

In another study conducted by Gazem et al. [27] on anticancer and anti-inflammatory potential of chia seed oil and its blends in vitro. The in vitro cancer cytotoxic traits capability of chia seed oil and its composites was assessed by (3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide) (MTT) and trypan blue assays using main cell lines including chronic myelogenous leukemia and others. The anti-inflammatory result of the chia seed oil and its composites was looked in to by evaluating the anti-lipoxygenase action in vitro. The results of the study reveal that incubation with chia seed oil considerably repressed the anti-lipoxygenase action as well as when blend with other vegetable oils. The authors came into conclusion that chia seed oil either used alone or when blend with other vegetable oils has proven to be a healthy supplement which also delays or prevents situations of degenerative disorders.

#### F. Chia Seeds Oil and the Cognitive Abilities

The impact of nutrition on cognitive ability in the academic literature is undisputed. Various studies have revealed that one can measure the effects of polyunsaturated fats and other diets such as milk or oils. Onneken [28] conducted a study to look into how chia seeds increase intelligence. The research

was based on the assessment of tests that evaluate cognitive performance. The participants were divided into two groups namely the intervention group and the control group. Those in the intervention group were consuming 5 grams of chia seeds on a daily basis for 21 consecutive days. The tests run included memory tests, sentence completion tests, and applied intelligence testing. Generally, those in the intervention group performed quite better as compared to those in the control group. The authors reached to a conclusion that a chia enriched diet has a progressive impact on cognitive abilities. This is being confirmed by two tests with a high significance as well as a memory task.

#### G. Chia Seeds Oil and Skin Health

Research studies have been conducted to evaluate the role of chia seed oil in healing cancer and tumors.

Salih [24] conducted a study whose aim was highlighting the efficiency of chia oil using color Doppler vascularity index. He used thirty male rats that were divided into two groups of 15 each. The first group was treated with chia oil and the second group was taken as the control experiment. Every animal was subjected to a surgical operation at the dorsum. This created a horizontal wound 2 cm long and whole skin depth. The wound was then treated with chia seed oil. Scarifications of the rats were done after a duration of 3, 7 and 10 days. There was a routine segmenting technique conducted for histological assessment. The results of this study revealed that re-epithelialization and transformation of skin fibrous tissues were hastened after the application of chia oil at the wounds. The study concluded that applying chia oil on wounds is very effective in improvement of the wound healing process in comparison to the controlled one.

## IV. CONCLUSION

Chia seeds usage has recently gained popularity in the modern world due to its catalogue of health benefits. Various research studies have been undertaken to determine the effect of chia seeds and chia seed oil. The results from these studies have revealed that chia seed and chia oil have benefits in cardiovascular disease, obesity and weight loss, diabetes, low cognitive performance, high levels of cholesterol, and bowel function regulation. This reveals that chia has a great potential in pharmaceutical, nutraceutical, and food industries. Most of these studies have been conducted on animals especially rats. There is need to do human trials in order to make better accurate conclusions.

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