



A Pharmacognostic Study on *Salvia Hispanica*

Avinash Rangaraju*¹, Uppala Mohan Kumar¹

1. Department of Pharmacognosy & Phytochemistry, Scient Institute of Pharmacy, Khanapur, Rangareddy, Hyderabad -501506. Andhra Pradesh, India

ABSTRACT

Chia seed (*Salvia hispanica*) is an ancient oilseed used by Mayas and Aztecs as foodstuff. This seed is a natural source of omega-3 fatty acids (α -linolenic acid), soluble and insoluble fibers, and proteins in addition to other important nutritional components, such as vitamins, minerals, and natural antioxidants. Chia can be considered as “functional food” because apart from contributing to human nutrition, chia helps to increase satiety index, prevent cardiovascular diseases, inflammatory and nervous system disorders, and diabetes, among others. Today, chia seed offers a huge potential in the industries of health, food, animal feed, pharmaceuticals, and nutraceuticals, among others, due to its functional components. However, the safety and efficacy of this medicinal food or natural product need to be validated by scientific research. In vivo and clinical studies on the safety and efficacy of chia seed are still limited. This paper covers the up-to-date research on the identified active ingredients, in vivo and human trials on the health benefit of chia seed, and its current market potential.

Keywords: *Salvia hispanica*, Scanning electron microscopy, chia seeds, omega 3-fatty acids

*Corresponding Author Email: avinash.86@aol.com

Received 06 December 2013, Accepted 13 December 2013

INTRODUCTION

Salvia hispanica commonly known as **Chia** is a species of flowering plant in the mint family, Lamiaceae, native to central and southern Mexico and Guatemala¹. The 16th-century *Codex Mendoza* provides evidence that it was cultivated by the Aztec in pre-Columbian times; economic historians have suggested it was as important as maize as a food crop². It is still used, sometimes with the seeds ground or with whole seeds used for nutritious drinks and as a food source^{3,4}.



Botanical and taxonomic classification⁵:

Kingdom : Plantae
Subkingdom : Tracheobionta
Superdivision : Spermatophyta
Division : Magnoliophyta
Class : Magnoliopsida
Subclass : Asteridae
Family : Lamiaceae
Genus : *Salvia*
Species : *hispanica*

Chia plant description

Chia (*Salvia hispanica* L.) is an annual herb that blooms during the summer months. It is approximately a meter tall, with opposite, petiolate and serrated leaves that are 4 to 8 cm long and 3 to 5 cm wide. The flowers are hermaphrodite and grow in numerous clusters in a spike protected by small bracts with long pointed tips. The seeds are oval, smooth and shiny, and are mottle-colored with brown, grey, dark red and white, and are generally found in groups of four

(Ayerza and Coates, 2005a, USDA, 2008)⁶. The plant has quadrangular stems that are ribbed and hairy. It grows in light to medium, clay and sandy soils, and even in arid soils that have good drainage but are not too wet. The plant is semi-tolerant to acid soils and drought. Chia is grown mainly in mountainous areas and has little tolerance to abiotic phenomena, such as freezing and sunless locations.



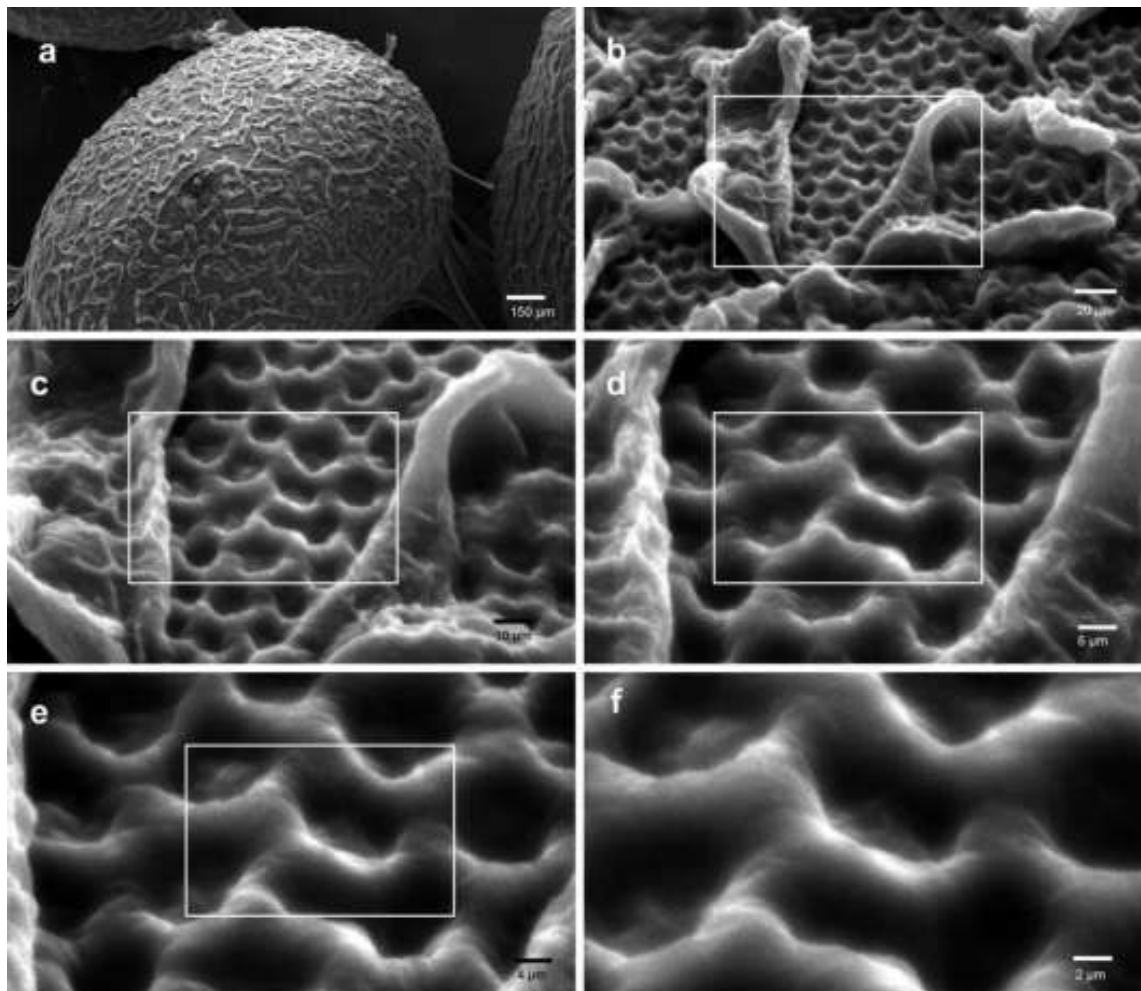
Chia flowering plant

Chia seed description

The seeds are small, oval-shaped and flat, and measure between 2 and 2.5 mm long, 1.2 and 1.5 mm wide, and 0.8 to 1 mm thick. Their color ranges goes from dark brown to black, and sometimes gray or white,; the white seeds are greater in weight, width and thickness than the darker ones (Ixtaina et al., 2008)⁷.



Clean and dry seeds can be kept for years as they contain antioxidants that prevent the deterioration of the essential oils held within. A principal feature of the seed is that when placed in an aqueous medium, it secretes a mucilaginous polysaccharide that surrounds the seed. It has been reported that consumption of this mucilage aids digestion and that, together with the seed, constitutes a nutritious food source (Salgado-Cruz *et al.*, 2005)⁸.



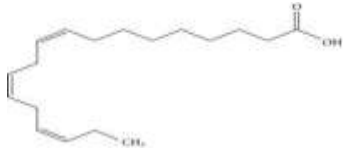

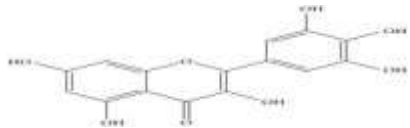
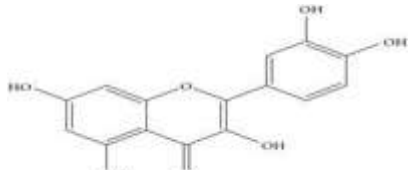
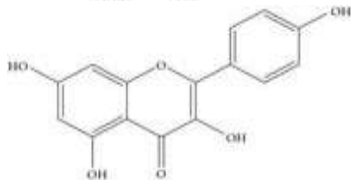
Scanning electron microscopy images of hydrated chia seeds

- (a) Whole chia seed hydrated and lately dried; note a thin film surrounding the seed.
- (b) (c) & (d) reveals a hexagonal structure. Membranes observed correspond to dry mucilage on the surface of the seed
- (e) & (f) in the center of each hexagonal structure shows the base of the columella.

Phytochemicals in chia seed

Various active ingredients including essential fatty acids and phenolic compounds have been identified in chia seed. These active compounds which contribute to the health benefits of chia seeds are summarized in Table 1.

Table 1: Phytochemicals in chia seed

Active compounds in	Chemical structure	Activities
<i>Salvia hispanica</i> L.		
Omega 3 alpha-linolenic acid; ω -3 ALA (18 : 3) (PUFA fatty acids)		(1) lowers TG and cholesterol levels, which in turn results in low blood pressure and heart-related diseases ⁹ ; (2) anti-inflammatory activity ^{10,11} ; (3) cardioprotective and hepatoprotective activities by redistributing lipid away from visceral fat and liver (4) antidiabetic action; (5) Protection against arthritis, autoimmune disease, and cancer.
Omega 6 linoleic acid; ω -6 LA (18 : 2) (PUFA fatty acids)		This FA has inflammatory, hypertensive, and thrombotic activities. ¹¹
Myricetin (flavonols and phenolic acids)		
Quercetin (flavonols and phenolic acids)		Antioxidant, anti-inflammatory, anticancer, and antithrombotic activities ¹¹
Kaempferol (flavonols and phenolic acids)		

Nutritional value of chia seeds

According to the USDA, a one ounce (28 gram) serving of chia seeds contains 9 grams of fat, 5 milligrams of sodium, 11 grams of dietary fiber and 4 grams of protein. The seeds also have 18% of the recommended daily intake of calcium, 27% phosphorus and 30% manganese, similar in

nutrient content to other edible seeds such as flax or sesame. Although preliminary research indicates potential for dietary health benefits, this work remains sparse and inconclusive.

Preliminary research

One pilot study found that 10 weeks ingestion of 25 grams per day of milled chia seeds, compared to intact seeds, produced higher blood levels of alpha-linolenic acid and eicosapentaenoic acid, an omega-3 long-chain fatty acid considered good for the heart, while having no effect on inflammation or disease risk factors.

Benefits of chia seeds

1. Combat Diabetes

Chia is being studied as a potential natural treatment for type-2 diabetes because of its ability to slow down digestion. The gelatinous coating chia seeds develops when exposed to liquids—can also prevent blood sugar spikes.

2. Good source of fibre

Just a 28-gram or one-ounce serving of chia has 11 grams of dietary fibre — about a third of the recommended daily intake for adults. Adding some chia to your diet is an easy way to make sure you're getting a good amount of fibre, which is important for digestive health and avoids constipation problems.

3. Omega-3 fatty acids

Chia seeds are packed with omega-3 fatty acids, with nearly five grams in a one-ounce serving. These fats are important for brain health. "There's better conversion of omega 3s into the plasma or into the food than with flax seed," said researcher Wayne Coates.

4. Stronger Teeth And Bones

A serving of chia seeds has 18 per cent of the recommended daily intake for calcium, which puts you well on your way to maintaining bone and oral health, and preventing osteoporosis.

5. Manganese

Manganese isn't a well-known nutrient, but it's important for our health: it's good for your bones and helps your body use other essential nutrients like biotin and thiamin. One serving of chia seeds, or 28 grams, has 30 per cent of your recommended intake of this mineral.

6. Phosphorus

With 27 per cent of your daily value for phosphorus, chia seeds also help you maintain healthy bones and teeth. Phosphorus is also used by the body to synthesize protein for cell and tissue growth and repair.

7. High Protein source

Chia seeds also make a great source of protein for vegetarians and don't have any cholesterol. One 28-gram serving of these super seeds has 4.4 grams of protein, nearly 10 per cent of the daily value.

8. Fights Belly Fat

Chia's stabilizing effect on blood sugar also fights insulin resistance which can be tied to an increase in belly fat, according to Live Strong. This type of resistance can also be harmful for your overall health.

9. Improves appetite

Tryptophan, an amino acid is also found in chia seeds. It helps to regulate appetite, sleep and improve mood.

10. Improves Heart Health

According to the Cleveland Clinic, chia seeds have been shown to improve blood pressure in diabetics, and may also increase healthy cholesterol while lowering total, LDL, and triglyceride cholesterol.

11. Help weight loss.

Chia seeds are popular for weight loss. They reduce food cravings by preventing some of the food that you eat from getting absorbed into your system. This blockage of calorie absorption makes them a great diet helper.

12. Chia seeds are also very good **anti-oxidants**. As such, they can be added safely to any detoxification programs.

13. Chia seeds are highly hydrophilic these seeds are excellent for athletes. The chia seeds can absorb huge amounts of water and so they are very good in hydrating the body.

Human clinical trials of chia seed

To date, four clinical trials have been carried out, and the details are summarized in Table [2](#). The difference could be due to the treatment durations employed and also the actual biochemical components of the dietary chia seed used in the various studies. Nevertheless, later studies demonstrated well the benefits of chia on human health. However, studies of chia's intake in human diet which take into consideration factors such as lifestyle and genetic variations are still limited. Hence, studies which target these factors should be done in the future.

Table 2: Human clinical trials of chia seed

Duration	Mode of trial	Formulation	Results	Ref.
7 weeks	10 postmenopausal women	25 g chia seed/day	Polyunsaturated fatty acid content particularly ALA, and eicosapentaenoic acid (EPA) was elevated after supplementation with milled chia. The result was in agreement with previous studies conducted in hens, rats, and rabbits.	12
12 weeks	Single blinded with 76 subjects (placebo 37; chia seed 39)	25 g chia seed in 250 mL water twice/day	Although Nieman et al. have hypothesized that the high dietary fiber and ALA content in chia can promote human weight loss and reduce disease risk factors related to heart disease and obesity, no significant results on weight loss and disease risk factors even though the plasma level of ALA increased.	13
2 months	Randomized trial, with control diet (500 kcal for 2 weeks), 67 metabolic syndrome subjects (placebo 35; beverage 32)	Beverage of 235 kcal that contains soy protein, chia seed, and oat	Body weight loss and reduction of triglyceride and blood glucose levels.	14
120 minutes	Randomized, double-blind trial on 11 healthy subjects	50 g white bread containing either 0, 7, 15, or 24 g of chia seed	Reduced postprandial glycemia.	15

Adverse Effects of Chia Seeds

- In some people, chia seeds can cause gastrointestinal disruptions. It leads to the formation of gas and a bloated feeling. This is because chia seeds have very high fiber content.
- Chia seeds can also cause allergy in some people. The chia proteins can cause adverse reactions. Those who are susceptible to allergic reactions by mustard seeds should also stay away from chia seeds as they can cause the same type of reactions. Chia seeds allergic reactions can cause watery eyes, vomiting, diarrhea, hives, skin rashes, and swelling of the tongue, mouth, and throat. They can also cause trouble in breathing.
- For people who are planning to undergo a surgery or are taking aspirin or blood thinners should consult a medical practitioner before using chia seeds.
- A study conducted in Canada found that chia seeds drastically reduce the diastolic blood pressure. So, people suffering with low blood pressure should avoid it.

- There is a very great chance of people getting addicted to chia seeds. To avoid this, chia seeds should be consumed in short phases with break periods in between.
- Pregnant and lactating mothers should also stay away from chia seeds. However, there are only a few researches to study the adverse effects of chia seeds on the pregnant and lactating mothers.

Future research prospects on chia seeds

Many different applications are emerging from the whole seed and the mucilage within which can be mentioned:

- Improve the mucilage extraction to offer to the food industry an attractive functional ingredient
- Explore different application in diverse food matrices
- Study its use in medicine, especially the action of mucilage on postprandial response in human and animal models
- Study the effect "in vivo" and/or "in vitro" on satiety and dyslipidemia
- Explore potential antioxidant effect of the plant extracts

CONCLUSION

The seeds of *Salvia hispanica* have enormous potential as a source of nutrients and nutraceuticals, of great interest to pharmacy, science & technology, food engineering. Among other nutrients, the seed possesses mucilage composed mainly of polysaccharides, located in the three layers forming the testa (seed coat) which can be easily removed after hydration and have the capacity to retain water 27 times its weight in water. The mucilage obtained from the seed is a soluble fiber and potential source of hydrocolloids with different functional properties that are sought by the food industry, such as: a high water retention capacity; emulsifier; thickener; stabilizer in the formation of foam, and highly soluble in both hot and cold water. This polysaccharide has the ability to form edible films in combination with proteins, so improving the film's mechanical and functional properties. Based on the current research findings; chia seed is a good choice of healthy oil to maintain a balanced serum lipid profile. However, unlike vitamin E and coenzyme Q₁₀, in vivo clinical bioactivity and safety evaluation of chia seeds are still limited. Furthermore, details on the mechanisms of chia seed's hypolipidemic effects need to be studied and compared with those of the isolated omega 3 and omega 6 fatty acids. Finally, it was concluded that the mucilage of *Salvia hispanica* represents a new functional ingredient with huge potential for the food, animal feed and pharmaceutical industries.

REFERENCES

1. *Salvia hispanica* L. Germplasm Resources Information Network. United States Department of Agriculture. 2000-04-19. Retrieved 2012-03-21.
2. Cahill, Joseph P. "Ethnobotany of Chia, *Salvia hispanica* L. (Lamiaceae)". *Economic Botany* 2003;57(4):604–618.doi:10.1663/0013-0001(2003)057[0604:EOCSHL]2.0.CO;2.
3. Kintzios, Spiridon E. (2000). *Sage: The Genus Salvia*. CRC Press. p. 17. ISBN 978-90-5823-005-8.
4. Stephanie Strom (November 23, 2012). "30 Years after Chia Pets, Seeds Hit Food Aisles". *New York Times*. Retrieved 2012-11-26. "Whole and ground chia seeds are being added to fruit drinks, snack foods and cereals and sold on their own to be baked into cookies and sprinkled on yogurt.
5. Hentry, H. S., M. Mittleman and P. R. Mc Crohan (1990). Introducción de la chía y la goma de tragacanto en los Estados Unidos. En: *Avances en Cosechas Nuevas. de la Madera*. Portland, Ohio, O. J.Janick y J.E. Simon: 252-256.
6. Ayerza, R. and W. Coates (2005a). Chia: Rediscovering an ancient crop of the Aztecs. University of Arizona Tucson, Arizona, USA.
7. Ixtaina, V. Y., S. M. Nolasco and M. C. Tomás (2008). "Physical properties of chia (*Salvia hispanica* L.) seeds." *Industrial Crops and Products* 28(3): 286-293.
8. B. Heuer, Z. Yaniv, and I. Ravina, "Effect of late salinization of chia (*Salvia hispanica*), stock (*Matthiola tricuspidata*) and evening primrose (*Oenothera biennis*) on their oil content and quality," *Industrial Crops and Products*, vol. 15, no. 2, pp. 163–167, 2002.
9. S. K. Jeong, H. J. Park, B. D. Park, and I. H. Kim, "Effectiveness of topical chia seed oil on pruritus of end-stage renal disease (ESRD) patients and healthy volunteers," *Annals of Dermatology*, vol. 22, no. 2, pp. 143–148, 2010. .
10. A. P. Simopoulos, "Omega-3 fatty acids in inflammation and autoimmune diseases," *Journal of the American College of Nutrition*, vol. 21, no. 6, pp. 495–505, 2002.
11. H. Poudyal, S. K. Panchal, J. Waanders, L. Ward, and L. Brown, "Lipid redistribution by α -linolenic acid-rich chia seed inhibits stearoyl-CoA desaturase-1 and induces cardiac and hepatic protection in diet-induced obese rats," *Journal of Nutritional Biochemistry*, vol. 23, no. 2, pp. 153–162, 2012.
12. F. Jin, D. C. Nieman, W. Sha, et al., "Supplementation of milled chia seeds increases plasma ALA and EPA in postmenopausal women," *Plant Foods For Human Nutrition*, vol. 67, pp. 105–

110, 2010.

13.D. C. Nieman, E. J. Cayea, M. D. Austin, D. A. Henson, S. R. McNulty, and F. Jin, “Chia seed does not promote weight loss or alter disease risk factors in overweight adults,” *Nutrition Research*, vol. 29, no. 6, pp. 414–418, 2009.

14.G. C. Martha, R. T. Armando, A. A. Carlos, et al., “A dietary pattern including Nopal, Chia seed, soy protein, and oat reduces serum triglycerides and glucose intolerance in patients with metabolic syndrome,” *Journal of Nutrition*, vol. 142, no. 1, pp. 64–69, 2012.

15.V. Vuksan, A. L. Jenkins, A. G. Dias et al., “Reduction in postprandial glucose excursion and prolongation of satiety: possible explanation of the long-term effects of whole grain Salba (*Salvia hispanica* L.),” *European Journal of Clinical Nutrition*, vol. 64, no. 4, pp. 436–438, 2010.



AJPHR is
Peer-reviewed
monthly
Rapid publication
Submit your next manuscript at
editor@ajphr.com / editor.ajphr@gmail.com