



Chia (*Salvia Hispanica*)

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Synonyms/Common Names/Related Substances:

Chian, chia, chia fresca, cryptotanshinone, dan shen (Chinese), danshen (Chinese), golden chia, ilepesh (Chumas), Lamiaceae (family), Mexican chia, millionone, pashi (Native American), pinole, running food, Salba®, *Salvia columbariae*, *Salvia hispanica* L., *Salvia miltiorrhiza*, *Salvia tiliafolia*, tanshinone, white Salba®.

Clinical Bottom Line/Effectiveness

Brief Background:

Salvia hispanica is an annual herbaceous plant of the Lamiaceae (mint) family. Its origin is believed to be in Central America, where the seed (historically called "chian" or "chia") was a staple in the ancient Aztec diet. The seeds of a related plant, *Salvia columbariae* (also called "golden chia"), were used primarily by Native Americans in the southwestern United States (1). The roots of another relative, *Salvia miltiorrhiza* (danshen), are used medicinally in China (2) and other countries (3).

The oval-shaped seeds of *Salvia hispanica* are approximately 1 mm in diameter and are dark-brown to grayish-white in color. According to historians, the cultivation of chia reportedly ended with the fall of the Aztec civilization; however, chia was rediscovered in the late 1900s and is now grown commercially. *Salvia hispanica* seeds are thought to be high in omega-3, 6, and 9 essential fatty acids and fiber; thus, it is promoted for various health benefits.

Studies have suggested that incorporating common chia into chicken feed may improve the nutritional value of chicken products by increasing the omega-3 content and decreasing the cholesterol content of the meat (4) and eggs (5).

Rodent studies have shown that *Salvia hispanica* may lower serum cholesterol, LDL (low density lipoproteins), and triglycerides while increasing HDL (high density lipoproteins) (6). Furthermore, *Salvia hispanica* has been demonstrated to exhibit anti-tumor activity (7).

Salba® is the only registered variety of *Salvia hispanica*, marketed by Core Naturals, LLC., which claims to be selectively bred to maximize nutrient value. Light in color, Salba® reportedly contains a more stable content of omega-3 fatty acids than generic dark-colored chia seeds. Recently, human study suggested that Salba® may decrease cardiovascular risk factors in type 2 diabetics (8). Thus far, Salba® is the only variety of *Salvia hispanica* supported by clinical evidence.

Quality of Scientific Evidence:

Indication	Evidence Grade	 Grading System
Cardiovascular disease prevention / atherosclerosis	B	

Historical or Theoretical Uses which Lack Sufficient Evidence:

Alcoholism (9), allergies (5), angina (1;3;10), anticoagulant (1;8), antioxidant (11), antiviral (11), athletic performance enhancement (1), cancer (4;7;12), celiac disease, constipation, coronary heart disease (CHD), death and dying (1), depression (4), diabetes (4), heart attack (1), hormonal/endocrine disorders, hunger, hyperlipidemia (3), hypertension (4), inflammation, ischemic injury (1), joint pain, kidney disorders (13), liver disease (14), metabolic disorders (electrolyte imbalances), neuroprotection (1), obesity, pancreatitis (15), skin conditions, stroke (1;5), tumors (7), vasodilatation (1).

Expert Opinion and Historic/Folkloric Precedent:

Salvia hispanica has been cultivated for its nutritional benefits as well as its reported medical benefits. Historically, the roots of the related plant *Salvia columbariae* (golden chia) were used as a treatment for stroke by Native Americans (1). The roots of another related plant, *Salvia miltiorrhiza* (danshen), are widely used to treat a variety of diseases in China (2), as well as in Japan, Europe, and the United States (3).

Brief Safety Summary:

Likely safe: When eggs and meat products from chickens fed with *Salvia hispanica* seed are consumed (4;5).

Possibly safe: When Salba® is used in type 2 diabetic patients for up to 12 weeks (8). Although Salba® may be relatively safe, gastrointestinal side effects and medication changes have been reported (8). The historical use of chia suggests that consuming *Salvia hispanica* seeds in reasonable quantities is possibly safe.

Possibly unsafe: When used in patients with gastrointestinal problems or hypotension, based on reports of

side effects (8). When the roots of *Salvia hispanica* are taken with warfarin, due to reported pharmacokinetic and pharmacodynamic interactions between the related *Salvia miltiorrhiza* (danshen) roots and warfarin (16; 17).

Likely unsafe: When used in patients with known sensitivity to members of the genus *Salvia*, and patients with food allergies (especially to sesame or mustard seeds) as cross-reactivity may occur, according to the Advisory Committee on Novel Foods and Processes.

Note: *Salvia hispanica* (chia or Salba®), *Salvia columbariae* (golden chia), and *Salvia miltiorrhiza* (danshen) are related but distinct plants with overlapping historical uses. Salba® is a registered variety of *S. hispanica* that is supported by clinical evidence.

Dosing/Toxicology

General:

Recommended doses are based on those most commonly used in available trials, or on historical practice. However, with natural products it is often not clear what the optimal doses are to balance efficacy and safety. Preparation of products may vary from manufacturer to manufacturer, and from batch to batch within one manufacturer. Because it is often not clear what the active component(s) of a product is, standardization may not be possible, and the clinical effects of different brands may not be comparable.

Standardization:

There is no well-known standardization for generic *Salvia hispanica* seed (chia) or the Salba® variety. Manufacturers of Salba® note that "Salba® is a standardized nutritionally consistent crop." There is a lack of available information about the percent standardization of certain nutrients in Salba®.

Dosing:

Adult (age ≥18):

Oral:

General: According to a report by the U.K. Advisory Committee for Novel Foods and Processes, average consumption for adults may be 2.1g daily, with a maximum consumption of 12.9g daily for adult males. *Salvia hispanica* seed has been studied for up to four weeks at a maximum dose of 10g. The recommended serving by the manufacturer for Salba® is 1Tbsp. (12g), which reportedly contains over 2,500mg of omega-3 fatty acids, 4.5g of dietary fiber, and various minerals.

Cardiovascular disease prevention: Salba® was provided as a food supplement at 33-41g daily, either in ground form or incorporated into bread, for 12 weeks (8). Although safety was established, there was a lack of available evidence to recommend for or against CVD.

Children (age <18):

General: According to a report by the U.K. Advisory Committee for Novel Foods and Processes, average consumption of *Salvia hispanica* for children ages 1.5-4.5 years may be 1.1g daily, with a maximum consumption of 3.2g daily. For children 4.5-19 years of age, average chia consumption may be 1.4g daily, with a maximum of 4.3g daily. The manufacturer of Salba® recommends up to 1Tbsp. daily for children.

Toxicology:

Toxicological safety of *Salvia hispanica* seed (generic chia) was assessed in humans as well as in animals and deemed satisfactory by the U.K. Committee for Novel Foods and Processes based on a report of 100 healthy subjects who were divided into four groups and given either 4g sunflower seeds (control) or 2.5g, 5g, or 10g of *Salvia hispanica* seeds daily for four weeks. No significant adverse effects were reported.

Precautions/Contraindications

Allergy:

Known allergy/hypersensitivity to chia, its constituents, or members of the genus *Salvia*.

According to a report by the U.K. Committee for Novel Foods and Processes, potential chia protein allergenicity was demonstrated by specific IgE binding and immunoblot analysis. It was proposed that chia-containing products carry statements cautioning consumers with food sensitivity, particularly those with allergies to sesame and mustard seeds.

Adverse Effects/Post Market Surveillance:

General: There is limited reported safety data on chia or Salba®, though the seeds of *Salvia hispanica* (generic chia) and *Salvia columbariae* (golden chia) have been used for centuries in the diets of Native and Central Americans. According to a report by the U.K. Advisory Committee for Novel Foods and Processes, consumption of up to 10g *Salvia hispanica* daily for four weeks did not produce any significant adverse effects. Gastrointestinal side effects were reported in one clinical trial that used Salba® as a dietary supplement (8). The roots of *Salvia columbariae* (golden chia) have been historically used by Native Americans to treat stroke (18), and the root of *Salvia miltiorrhiza* (danshen) is widely accepted as a safe and effective stroke treatment in China and a number of foreign countries (3). However, there is also limited safety data on the roots of the

genus *Salvia*.

Gastrointestinal: Gastrointestinal side effects were reported in one clinical trial that examined whether supplementing the diet with the Salba® variety of *Salvia hispanica* would improve major risk factors for cardiovascular disease (CVD) in patients with type 2 diabetes (8).

Precautions/Warnings/Contraindications:

Use cautiously in patients with hypotension or taking blood pressure medication, as Salba® may lower blood pressure (8).

Use cautiously in patients with known sensitivity to members of the genus *Salvia* and patients with food allergies (especially to sesame or mustard seeds) as cross-reactivity may occur.

Avoid in patients taking warfarin, due to reported pharmacokinetic and pharmacodynamic interactions between the related *Salvia miltiorrhiza* (danshen) roots and warfarin (16;17).

Pregnancy & Lactation:

Not recommended due to lack of sufficient data.

Interactions

Most herbs and supplements have not been thoroughly tested for interactions with other herbs, supplements, drugs, or foods. The interactions listed below are based on reports in scientific publications, laboratory experiments, or traditional use. You should always read product labels. If you have a medical condition, or are taking other drugs, herbs, or supplements, you should speak with a qualified healthcare provider before starting a new therapy.

Chia/Drug Interactions

Anticoagulants: In theory, the roots of *Salvia hispanica* may interact with warfarin, due to reported pharmacokinetic and pharmacodynamic interactions between the related *Salvia miltiorrhiza* (danshen) roots and warfarin (16;17).

Antihypertensives: Salba® may lower blood pressure (8).

Antineoplastic agents: *Salvia hispanica* oil has been reported to inhibit tumor growth in a murine model of adenocarcinoma (7).

Cytochrome P450 metabolized agents: Drug-metabolizing enzymes may be affected by extracts of *Salvia hispanica*, based on reported interactions between cytochrome P450 metabolized agents and *Salvia miltiorrhiza* (19).

Chia/Herb/Supplement Interactions

Anticoagulants and antiplatelets: In theory, the roots of chia *Salvia hispanica* may interact with other herbs that exhibit anticoagulant properties, such as *Ginkgo biloba* (ginkgo), *Allium sativum* (garlic), and *Angelica sinensis* (dong quai) (16).

Antineoplastics: A diet supplemented with *Salvia hispanica* seed oil has been reported to inhibit tumor growth in a murine model of adenocarcinoma (7).

Antioxidants: According to Core Naturals LLC, Salba® contains a significant amount of antioxidants; therefore, *Salvia hispanica* seed may have additive effects when combined with other supplements that are antioxidants, such as vitamins A, C, and E.

Cytochrome P450 metabolized herbs and supplements: Drug-metabolizing enzymes may be affected by extracts of *Salvia hispanica*, based on reported interactions between cytochrome P450 metabolized agents and *Salvia miltiorrhiza* (19).

Hypotensives: Because Salba® may lower blood pressure (8), it may interact with herbs and supplements that affect blood pressure such as omega-3 fatty acids, fish oil, and alpha-linolenic acid (ALA).

Omega-3 fatty acids, fish oil, alpha-linolenic acid: *Salvia hispanica* seed may contain high amounts of omega-3 fatty acids, fiber, and alpha-linolenic acid (20).

Chia/Food Interactions

Antioxidants: According to Core Naturals LLC, Salba® is rich in antioxidants; therefore, *Salvia hispanica* seed chia may have additive effects when combined with other foods that have significant amounts of antioxidants.

Chia/Lab Interactions

Blood pressure: In one study, Salba® significantly lowered systolic blood pressure in type 2 diabetic patients (8). Therefore, a diet containing *Salvia hispanica* seed may in theory affect blood pressure tests.

Coagulation panel: The root extracts of *Salvia columbariae* (golden chia) and *Salvia miltiorrhiza* (danshen) are reported to contain compounds that act as anticoagulants; thus, the roots of *Salvia hispanica* may contain similar activity (1).

Mechanism of Action

Pharmacology:

Constituents: The seed of *Salvia hispanica* (chia) is rich in unsaturated fatty acid (omega-3 and omega-6), dietary fiber, and folic acid (21). *Salvia hispanica* seeds are composed of approximately 30% oil (22), which is reported to contain 17-26% linoleic acid and 50-57% linolenic acid (23). The protein content of chia seed is approximately 23.4% (22). Hens that are fed diets containing 20% *Salvia hispanica* seed reportedly lay eggs with higher omega-3 fatty acid content (5). A recommended serving for Salba® is 2Tbsp. (15g), which reportedly contains over 3,000mg of omega-3 fatty acids, 5g of dietary fiber, and various minerals. According to the manufacturer, Core Naturals LLC, Salba® is the richest natural source of omega-3 fatty acids and fiber. Salba® is also reported to contain significant quantities of calcium, iron, potassium, vitamin C, magnesium, folate, B vitamins, zinc, selenium, and vitamin A.

Anticancer effects: There is preliminary evidence that the oil from *Salvia hispanica* seed may be an effective anticancer agent. A diet supplemented with chia oil reduced tumor growth and metastasis in a mouse model of mammary gland adenocarcinoma (7). Mice were fed control diets or diets supplemented with either *Salvia hispanica* oil or safflower oil. The diets supplemented with *Salvia hispanica* oil significantly reduced tumor mass and metastasis number ($p < 0.05$). Further analysis revealed that the decreased tumor growth and metastasis was due to decreased mitosis and a larger number of apoptotic cells. Further studies are needed to determine if oil from *Salvia hispanica* has similar effects in humans.

Anti-coagulation effects: The root extracts of *Salvia columbariae* (golden chia) and *Salvia miltiorrhiza* (danshen) are reported to contain miltionone II, cryptotanshinone, and tanshinone IIA; these compounds have various pharmacological activities, including anticoagulation, vasodilatation, and inhibition of nitric oxide (NO) synthase (1). It is unclear whether *Salvia hispanica* possesses these actions as well.

Antioxidant effects: Organic compounds found in *Salvia hispanica* seed, such as quercetin and kaempferol, may contribute to antioxidant effects; caffeic acid and chlorogenic acids are also present in small quantities (20).

Cardioprotective effects: Ayerza et al. conducted a study in 32 male Wistar rats to determine if the 18:3n-3 fatty acids found in chia seed would positively influence serum lipid parameters (6). The whole seed diet significantly reduced serum triglycerides ($p < 0.05$), and the ground chia seed diet increased HDL levels ($p < 0.05$). All chia diets significantly improved the fatty acid ratios of plasma.

Cytochrome P450 (CYP450) effects: Drug-metabolizing enzymes may be affected by extracts of *Salvia miltiorrhiza* (19). In theory, the effects of drugs or herbs may be altered when taken concurrently with members of the genus *Salvia*, although it is unclear whether *Salvia hispanica* exhibits the same effects.

Pharmacodynamics/Kinetics:

Insufficient available evidence.

History

The origin of *Salvia hispanica* is believed to be in Central America, where its seed (chia) was roasted and ground into "pinole" and incorporated into many foods in the ancient Aztec diet. Aztec messengers were reputed to consume chia seeds to sustain energy, and it was known as "running food" (8). The cultivation of chia reportedly ended with the fall of the Aztec civilization; however, the nutritional value of chia was rediscovered in the late 1900s with the development of Salba®, a variety of *S. hispanica* bred to maximize nutritional value.

Salvia hispanica seeds are used in a type of collectible terra cotta figurine known as the Chia Pet®. Moistened *Salvia hispanica* seeds are spread on the surface of a Chia Pet®, where they sprout within days. The Chia Pet® line was originally made in the shape of animals, with the sprouts resembling fur. Chia Pet® is now available in the likeness of numerous characters in popular culture.

Salvia hispanica and related species were revered by ancient cultures for their purported nutritional and medical benefits. Chia seeds were consumed by the Chumash Native Americans to enhance physical performance. The root of the *Salvia hispanica* plant was purportedly used to "wake the dead" by the Chumash; similarly, the roots of *Salvia miltiorrhiza* (danshen) were used historically in China as a treatment for stroke and a host of other diseases (2).

Evidence Table

Condition	Study Design	Author, Year	N	Statistically Significant?	Quality of Study 0-2=poor 3-4=good 5=excellent	Magnitude of Benefit	ARR	NNT	Comments
Cardiovascular disease prevention / atherosclerosis	Randomized controlled trial, single blind, crossover design	Vuksan, 2007	27	Yes	3	Medium	NA	NA	Possible changes in diet and activity were not addressed.

Evidence Discussion

Cardiovascular disease prevention / atherosclerosis

Summary: There is empirical evidence from rodent study (6) and clinical study (8) that diets containing *Salvia hispanica* seed may decrease the risk factors for cardiovascular disease (CVD). The preliminary evidence suggests that the benefits of Salba® in humans are comparable to other whole grains. Further study is warranted, including examination of the functional constituents of *Salvia hispanica* seed.

Evidence: Vuksan et al. performed a single-blind, crossover, randomized controlled trial to determine whether supplementing diet with *Salvia hispanica* (Salba®) would improve major risk factors for cardiovascular disease (CVD) in patients with type 2 diabetes (8). Eligible study participants had documented type 2 diabetes for at least six months, without any clinical complications. The study recruited 27 subjects between 18 and 75 years of age, metabolically stable, and not taking insulin. Subjects were excluded from participation if pregnant or taking supplements that contained fish oil, fiber, or alpha-linolenic acid (ALA). Subjects were not allowed to consume coldwater fish more than three times per week. The participants were excluded from the study for any changes in medication, non-compliance (<50% of the supplements consumed), or if they experienced significant weight change during the study. Subjects were randomly assigned to receive either treatment (Salba®) or control (wheat bran), at a dose of 15g/1,000kcal of food intake (33-41g) daily for 12 weeks. After a washout period of four to six weeks, the subjects were crossed over to the alternate treatment for another 12 weeks. No toxic effects were noted; however, two subjects discontinued treatment citing gastrointestinal side effects. Three patients dropped out due to medication changes, and three refused to continue the study. Efficacy measures included glycemic control (A1C, fasting glucose, and fasting insulin levels), blood pressure, and blood lipids (total cholesterol, LDL, HDL, and triglycerides). The CVD risk factors measured included high-sensitivity C-reactive protein (hs-CRP), von Willebrand factor (vWF), and factor VIII. When compared with the control treatment, Salba® lowered systolic blood pressure (SBP) by 6.3 ± 4 mmHg ($p < 0.001$), hs-CRP by $40 \pm 1.5\%$ ($p = 0.04$), and vWF by $21 \pm 0.3\%$ ($p = 0.03$). While this study demonstrated the safety of supplementing diets with Salba® for type 2 diabetic patients, did not identify the specific functional component(s) of Salba® for any of the observed effects. Furthermore, possible changes in diet and activity were not addressed. Nonetheless, the beneficial effects observed were similar to other whole grains and further inquiry into the cardioprotective role of Salba® is warranted.

Products Studied

Brands used in statistically significant clinical trials:

Salba® (Salba Nutritional Solutions, Inc., Toronto, Canada) (8).

Note: Core Naturals of Winter Springs, Florida is the exclusive distributor for Salba® nutritional products in the United States. According to Core Naturals, LLC, "ImmuneShield" Salba® seed oil and Salba® "powder" are illegitimate Salba® products that have been marketed, and these are not authorized products. Swiss Labs, using an address in Naples, Florida, and/or Kankakee, Illinois, may be involved, among others.

Brands shown to contain claimed ingredients through third-party testing:

Consumer Lab: NA. Last accessed 3/17/08.

Consumer Reports: NA. Last accessed 3/17/08.

Natural Products Association: NA. Last accessed 3/17/08.

NSF International: NA. Last accessed 3/17/08.

U.S. Pharmacopeia: NA. Last accessed 3/17/08.

U.S. equivalents of most commonly recommended European brands:

Not applicable.

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Blinded Peer-Review: Natural Standard Editorial Board.

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Natural Standard developed the above evidence-based information based on a thorough systematic review of the available scientific articles. For comprehensive information about alternative and complementary therapies on the professional level, go to www.naturalstandard.com. Selected references are listed below.

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