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## Health benefits and utilization of Chia seed mucilage: A review

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#### Abstract

Chia (*Salvia hispanica*) is reported to have potential medical advantages identifying with this impairment. Polysaccharides extracted from Chia (*Salvia hispanica*) seed have gathered huge interest inside the food business lately because of their extraordinary practical properties. Known as chia adhesive (CM), it is a utilitarian fixing with a high measure of dietary fiber and large scale and miniature supplements. CM additionally contains a wealth of wellbeing advancing oligosaccharides that can be consolidated into food sources for great stomach wellbeing. Moreover, chia seeds contain other nutritionally relevant compounds, such as antioxidants (chlorogenic acid, caffeic acid, myricetin, quercetin, and kaempferol), gluten free protein containing all the essential amino acids, dietary fibres, and minerals. Study on chia seeds is receiving increasing interest because of their nutritional and health promoting properties. Hence, the purpose of this study is to develop a value-added food product using chia seeds and to assess the nutritional properties, shelf life and consumer acceptability of the developed product. Intrinsic characteristics of chia seeds can improve the quality of muffins, cookies (Other bakery products) and bring health benefits to the consumers.

**Keywords:** Chia seed, nutritional value, health benefits and value addition

#### Introduction

Chia (*Salvia hispanica* L.) is an angiosperm plant from the mint family (Lamiaceae) described as a grain from tropical and subtropical environments. It was broadly burned-through in pre-Columbian America by the Aztecs, in the area that incorporates Mexico and Guatemala (Ayerza *et al.*, 1995). Chia seeds started to be utilized in human food around 3500 BC, and obtained significance as a staple harvest in focal Mexico somewhere in the range of 1500 and 900 BC (Falco *et al.*, 2017). They involved the seeds for the arrangement of different medications, food and works of art. It was one of the principal yields of pre-Columbian social orders, outperformed exclusively by corn and beans. At the hour of the Conquest there was various plant species, four of which stuck out according to a dietary perspective: amaranth (*Amaranthus hypochondriacus*); beans (*Phaseolus vulgaris*); chia (*Salvia hispanica* L.) and corn (*Zea mays*). The seeds of chia, corn, beans and amaranth shaped the primary parts of the eating routine of the Pre-Columbian people groups of the Americas whose abstains from food that, contrasted and their cutting-edge partners, met the dietary prerequisites laid out today by the Food and Agriculture Organization and the World Health Organization. These sorts of seed were perceived for their nourishing and restorative properties by the old civilizations that possessed South America. (Ayerza *et al.*, 2005).

Chia (*Salvia hispanica* L.) is a yearly spice that blossoms throughout the late spring months. This plant might arrive at 1 m in level. Its serrated leaves, organized inverse, are 4-8 cm long and 3-5 cm in width (Munoz *et al.*, 2013). The seeds are oval, smooth and sparkly, and are mottle-hued with brown, dim, dim red and white, and are for the most part found in gatherings of four (Ullah *et al.*, 2015). The blossoms are bisexual and fill in various bunches in a spike safeguarded by little bracts with long pointed tips. The leaves contain natural oils that go about as bug anti-agents, subsequently the plant can be developed without pesticides or other substance compounds (Villalobos *et al.*, 1997). The plant has quadrangular stems that are ribbed and bushy. It fills in light to medium, mud what's more, sandy soils, and, surprisingly, in bone-dry soils that have great seepage yet are not excessively wet. The plant is semi-open minded to corrosive soils and dry season. As of now, it is developed around the world, especially in Argentina, Peru, Paraguay, Ecuador, Mexico, Nicaragua, Bolivia, Guatemala and Australia. In Europe, it is filled in nurseries (Coates *et al.*, 2011).

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Being hydrophilic, they can ingest fluid up to multiple times of their weight when splashed. When chia seeds are absorbed water, an unmistakable adhesive gel is delivered shaping a profoundly thick arrangement. (Munoz *et al.*, 2012), (Cruz *et al.*, 2013). When the chia seed is drenched in water, a straightforward adhesive gel called of chia mucilage (CM), is radiated. This gel is made basically out of dissolvable fiber and compares to about 6% of chia seed (Caudillo *et al.*, 2008), giving off an impression of being contained in the seed coat or the neighboring layer, not being effortlessly isolated from the seed (Campos *et al.*, 2014).

Chia mucilage has been explored for its potential as a fat replacer. The adhesive of chia seed is an intricate high sub-atomic weight polysaccharide removed when the seed comes into contact with the water, expanding the arrangement thickness (Lin and Daniel, 1994). These intricate polysaccharides are thought about dietary fiber, and admission can lessen cholesterol levels and assists with gastrointestinal capacity. Adhesive can likewise be utilized in intriguing mechanical applications like thickeners, gel formers and chelators (Capitani *et al.*, 2012). The gel framed has characteristics that permit its application in different items in the food business (Ali *et al.*, 2012), like thickener, gel previous and chelator (Capitani *et al.*, 2012). Also, it can go about as a fat replacer on the grounds that it has the ability to hydrate, create thickness and look after newness, especially in pastry kitchen items (Ovando *et al.*, 2009). Thus in the present review health benefits and utilization of chia mucilage has been discussed in detail.

### Nutritional Value

Chia seeds are reported to be good source of fiber, protein, lipids and minerals, respectively. Chia seeds contains somewhere in the range of 34 and 40 g of dietary fiber per 100 g, identical to 100 percent of the day-to-day proposals for the adults. This fiber content is higher than quinoa, flaxseed and amaranth. In this manner, chia seed can be utilized in the anticipation of numerous cardiovascular illnesses and diabetes, among others, as exhibited by various epidemiological examinations (Marlett *et al.*, 2002). On other hand, the utilization of dietary fiber has been related with the increments of post-supper satiety and diminishes hunger (Archer *et al.*, 2004). Chia seed is reported to have protein in the range 19-27% (Weber *et al.*, 1991). Chia seeds are wealthy in omega-3 unsaturated fats with a yield of 25–30% extractable oil, including  $\alpha$ -linolenic corrosive. The arrangement of the fat of the oil might be 55% omega-3, 18% omega-6, 6% omega-9 (National Nutrient Database USDA, 2010). Chia is referred to as super food as it contains profoundly focused measures of fundamental unsaturated fats, dietary strands, nutrients and cancer prevention agents (Weber *et al.*, 1991). In one ounce (28 g) test, chia seeds contain 9% of day by day an incentive for protein, 13% oil (57% of which is  $\omega$  - linolenic corrosive contracted as 3ALA) and 42 percent dietary fiber, in light of a day-by-day admission of 2000 calories. Chia seeds are found to be rich in minerals *viz.* phosphorus, manganese, calcium, potassium and sodium (Mysterious, 2010). The seed contains critical groupings of essential and synergistic normal cancer prevention agents, for example, chlorogenic corrosive, caffeic corrosive, myricetin, quercetin and kaempferol (Taga *et al.*, 1984). Chia seeds are reported to be a good source of vitamin B complex: thiamine (0.62 mg/100 g), riboflavin (0.17 mg/100 g), niacin (883 mg/100 g) and folic corrosive (49 mg/100 g) (Nutritional

Nutrient Database, 2011).

### Health benefits of chia seed

Ali *et al.*, (2012) studied about the promising future of chia, *Salvia hispanica* L. He quoted that with increasing public health awareness worldwide, demand for functional food with multiple health benefits has also increased. The use of medicinal food from folk medicine to prevent diseases such as diabetes, obesity, and cardiovascular problems is now gaining momentum among the public. Seed from *Salvia hispanica* L. or more commonly known as chia is a traditional food in central and Southern America. Currently, it is widely consumed for various health benefits especially in maintaining healthy serum lipid level. Munoz *et al.* (2013) quoted that 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 nutraceutical, among others, due to their functional components. Grancieri *et al.*, (2018) also found chia seeds as a source of proteins and bioactive peptides with health benefits. They identified the composition and the beneficial effects of chia seeds (*S. hispanica* L.), their proteins, peptides, and their potential impact on human health. The analyses of amino acid sequences showed peptides with bioactive potential, including dipeptidyl peptidase-IV inhibitors, angiotensin-converting enzyme inhibitors, and antioxidant capacity. These results correlated with the main health benefits of whole chia seed in humans such as antioxidant capacity, and hypotensive, hypoglycaemic, and anticholesterolemic effects. Such relation can be associated with chia protein and peptide compositions and therefore needs further investigation *in vitro* and *in vivo*. In 2016, Gazem *et al.*, studied about the pharmacological properties of chia seeds. Dietary supplementation of chia seed oil in rats and humans has demonstrated alleviation of serum lipid profile and diabetic severity. In addition, chia seed oil also acts as an antioxidant *in vivo* and modulates the antioxidant enzyme activities in liver and blood. Dietary chia provides an array of pharmacological properties, however understanding the nature of bioactive and fatty acids responsible for its biological activity using mechanistic approaches in cell and mammalian models are a prerequisite prior to its usage as a therapeutic agent or functional food.

### Chia mucilage

When the chia seed is drenched in water, a straightforward adhesive gel called of chia mucilage (CM), is radiated. This gel is made basically out of dissolvable fiber and compares to about 6% of chia seed (Caudillo *et al.*, 2008), giving off an impression of being contained in the seed coat or the neighboring layer, not being effortlessly isolated from the seed (Campos *et al.*, 2014).

### Extraction of chia mucilage

The hot extraction of mucilage depends on the philosophy proposed by (Munoz *et al.*, 2012). Tests of 100 g of entire seeds were added to compartments containing refined water in the seed: water proportion of 1:40. The pH was changed and kept up with at the worth 8, and the temperature kept up with at  $80 \pm 1.5$  C utilizing a temperature regulator. The blends were attractively mixed and hydrated for 2 h. Then the water

suspension was spread onto a drying plate and presented to temperatures of 50 °C for 48 h. The seed adhesive was isolated by sieving on a 40 cross section screen, and afterward getting the heaviness of the mash.

For the cool extraction, the examples of 100 g of entirety seeds were added to holders containing refined water in the seed: water proportion of 1:10, 1:20, 1:30 and 1:40. The pH was changed and kept up with at 8.0 and the temperature esteem at 27 °C utilizing a temperature regulator. The combinations by squeezing controlled at 313 kgf/cm<sup>2</sup>. Subsequent to squeezing, the freezing of the tests was acted in a ultra-freezer (Sanyo VIP TM Series, Model MDF-U53VA) at – 86 °C and dried in freeze-drier (Liobras Ltda., Model L101, Saõ Carlos/SP, Brazil). Every one of the tests were performed with three reiterations. The freeze-drier working temperature was – 50°. The finish of freeze-drying process was laid out after the gadget arrives at the 100 mm Hg pressure that happened after 72 h of activity. The freeze-dried adhesive was then weighed to work out the yield.

### Utilization of chia seeds into food industry

Because of the hydrophilic properties of chia seeds, they are utilized alternative for eggs and Fat (Ding *et al.*, 2018). Chia seeds can assimilate water in sums as much as 12-overlap more prominent than their own mass (Munoz *et al.*, 2012). They furnish food with trademark consistency. As of now, chia seeds are utilized entirety, ground and as gel and oil. Gel of chia seeds might be utilized as a substitute of oil or eggs in prepared items. Such application works with decreased calorie and fat items in items. Moreover, on account of prepared merchandise, the end result has a more noteworthy substance of omega-3 acids, which are major organic mixtures vital for human wellbeing. Sung *et al.*, (2020) <sup>[54]</sup> worked in the planning of incorporating chia seed flour into without gluten rice layer cake. Result showed that incorporation of 10% prehydrated chia seed flour is seriously charming volume document of sans gluten layer cake and it is feasible for without gluten layer cake application. Without gluten layer cakes with improved quality ascribes and high sound advantage can be delivered by the union of chia seed flour. In 2020 <sup>[53]</sup>, Sharma *et al.*, investigated effect of chia seeds incorporation on nutritional quality of muffin mix. They come up with the result that muffin blend made with chia seeds had altogether higher mineral substance (calcium, phosphorus, zinc and iron) than did the control. The created item had a time span of usability soundness of a quarter of a year as far as dampness content, peroxide worth and all out bacterial tally and was all around acknowledged by buyers. In a similar study, Ramos *et al.*, (2020) <sup>[38]</sup> investigated effect of chia as breadmaking ingredient on nutritional quality, mineral availability, and glycaemic index of bread. Result showed that bread with chia had a high measure of linoleic corrosive, particularly in bread with chia seeds, attributable to assurance of seed trustworthiness during heating. Chia fixings didn't show restricting fundamental amino acids like lysine, which is insufficient in cereals. Glycaemic file was lower in bread with chia fixings contrasted with control. The helpful consequences for glucose digestion along with the wholesome and utilitarian attributes could be clinically significant for

counteraction of metabolic illnesses. Light cream cheddar was developed by Boldori *et al.*, (2020) <sup>[11]</sup> with the addition of chia seeds. The target of this investigation was to create cream cheese with low fat substance and adding chia seeds. They cited that the arrangement of cream chesse without adding fat and diminished fat were not well tangible acknowledgment. Be that as it may, the cream chesse made with chia seed without lessening fat or incomplete substitution (half) of fat got brilliant acknowledgment by the evaluators. They accordingly reason that chia seeds couldn't supplant the tangible properties of fat in without fat cream cheddar arranged. Be that as it may, the expansion of chia seed as a wellspring of fiber was all around acknowledged both in entire and diminished fat substance cream chesse. Kulkarni *et al.*, (2020) <sup>[31]</sup> studied about the determination of cooking quality of the composite flour noodles incorporated with chia seeds powder. Results obtained showed that cooking time increments with expansion in degree of chia seeds powder. Cooking misfortune diminished with the expansion of chia seeds powder. Water take-up and cooked weight were expanded. Another research was conducted by Puri *et al.* in 2019 <sup>[45]</sup>, on the nutritional value of snacks made from gramme flour fortified with chia seeds. The increase in the amount of chia seed flour reduced the sensory quality and agreeableness scores. They quoted those snacks containing 50:0 (gram: chia) was satisfactory according to the general worthiness. There was an extensive expansion in the fiber and mineral substance in the bites by adding chia flour. Consequently, the created snacks showed the business extent of assembling great quality tidbits, which will be useful for giving every day dietary necessity of protein, dietary fibre and different minerals. Eker *et al.*, (2020) <sup>[18]</sup> studied about the influence of the addition of chia seeds and germinated seeds and sprouts on the nutritional and beneficial properties of yogurt. The expansion of chia seeds caused the discovery of  $\alpha$ -linolenic and linoleic acids in CY (yogurt containing chia seeds) and CGY (Yogurt containing both chia seed and germinated seed and sprouts of lentils and cowpea). Strangely, the  $\alpha$ -lactalbumin ( $\alpha$ -lac) band didn't vanish after *in vitro* gastric and intestinal assimilation. The utilization of protease and carbohydrase to the undigested part of PY (plain yogurt) caused the arrival of acidic, butyric, and propionic acids. Propionic corrosive was not found in the enzyme treated undigested parts of CY, GY (yogurt containing germinated seed and sprouts of lentil and cowpea), and CGY. Likewise, *in silico* absorption showed that the PY proteins displayed a dipeptidyl peptidase IV inhibitory action. In 2021, Rani *et al.*, <sup>[48]</sup> investigated the use of pumpkin and chia seed as dietary fibre sources in meat preparations. Chia seeds have become one of the most popular superfood sources in the wellness community. It is an incredible wellspring of dietary fiber which is useful for the stomach related wellbeing and furthermore having higher convergence of useful unsaturated fats, gluten free protein, nutrient, minerals, and phenolic compounds. It is likewise a brilliant wellspring of omega-3 unsaturated fat in view of higher extent of  $\alpha$ -linolenic corrosive. So, this audit sums up the healthful, physicochemical and remedial impact of pumpkin and chia seeds in meat and meat items.

**Table 1:** Food products developed by using chia seed

Product Name	Raw material	Author's
MUFFINS	Chia flour	Aranibar <i>et al.</i> , (2019) <sup>[4]</sup>
COOKIES	Chia seed	Chelladurai <i>et al.</i> , (2019) <sup>[13]</sup>
BISCUITS	Chia flour	Divyashree <i>et al.</i> , (2016) <sup>[16]</sup>
GLUTEN FREE BREADS	Chia seed	Garda <i>et al.</i> , (2012)
NUTRITIONAL BAR	Chia seed	Alvarado-Rupflin (2011)
CAKES	Chia mucilage	Fernandes <i>et al.</i> , (2017) <sup>[19]</sup>
NOODLES	Chia seed powder	Kulkarni <i>et al.</i> , (2020) <sup>[31]</sup>
YOGURT	Chia mucilage	Ayaz <i>et al.</i> , (2017)

**Fig 1:** Chia (a) Plant; (b) Seeds; (c) Mucilage extracted from Chia seed

### Conclusion

Chia seeds are functional food and are highly nutritious. It contains a variety of antioxidant phenolic compounds that make them natural antioxidants for the oils and fats. Bakery products incorporated with chia seeds are in highly demand these days. As chia seeds can be added into bakery products to enhance its nutritional value. Various bakery products like bread, muffins, cookies and cakes, antioxidant activity increases when chia seeds are added into it. It helps in enriching a food and helps in lowering the Glycaemic Index of a product. When added into muffins and cookies, there is no baking loss and its volume is also not affected. It helps in enhancing the sensory attributes of a product and extends its shelf life. Chia in baked goods for example is beneficial not only to improve the nutritional value but acting as hydrocolloid or substitute egg, fat or gluten. The increase of oil stability and applications as food thickener in novel food applications are of high importance too. Market demand for healthy foods low in fats, has been increased day by day and utilization of different chia fractions would provide options for applications the utilization of chia seed in varied types of food products.

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