Advances in
Biotechnology & Microbiology
ISSN 2474-7637

Juniper Publishers
key to the Researchers

Review Article
Volume 5 Issue 2 – August 2017
DOI: 10.19080/AIBM.2017.05.555662

Adv Biotech & Micro


# Advances in Chia Seed Research

**Ranjana Deka and Akan Das***

*Department of Applied Biology, University of Science and Technology Meghalaya (UTSM), India*

**Submission:** July 29, 2017**; Published:** August 17, 2017

***Corresponding author:** Akan Das, Department of Applied Biology, University of Science and Technology Meghalaya (USTM), Ri-Bhoi, Meghalaya, 793101, India; Tel: +91-8011726712; Email: dasakan@gmail.com

**Abstract**

Chia (*Salvia hispanica L.*) is a tiny edible seed that comes from an annual herbaceous plant, *Salvia hispanica L.*. Chia seeds are highly valued for their nutritional properties and medicinal value. It contains healthy omega-3 fatty acids, polyunsaturated fatty acids, dietary fiber, and protein-including all essential amino acids, vitamins, calcium and other important minerals. Besides, it is also a rich source of polyphenols and antioxidants. Rosmarinic acid and daidzein were the two major phenolics present in Chia seed along with the presence of myricetin, quercetin, kaemferol, caffeic acid, flavonol glycosides and chlorogenic acid. Genomics research on Chia has started very recently, because of which there is little information available in biological databases. In a recent study, next generation sequencing based analysis revealed candidate genes of lipid biosynthesis and oil accumulation in different stages of Chia seeds. In this review, nutritional properties, phytochemicals and genomic research of Chia seeds have been discussed.

**Keywords:** Chia; Seeds; Omega fatty acids; Polyphenol; Genomic

## Opinion

**Figure 1:** Chia plant (left side) and seeds (right side).

Chia (*Salvia hispanica L.*) is an edible seed that comes from an annual herbaceous plant, *Salvia hispanica L.* of mint family (Lamiaceae) (Figure 1). The shape of Chia seed is oval with 1 to 2mm in size, which may be black, grey or black spotted to white in colour. Chia means strength and the tiny seeds have been used as energy booster. Chia seeds can be used in the form of whole seeds, mucilage, flour, and oil seed [1]. Chia seeds are highly valued for their nutritional properties and medicinal value. It contains healthy omega-3 fatty acids, polyunsaturated fatty acids, dietary fiber, and protein-including all essential amino acids, vitamins, calcium and other important minerals [2,3]. In water, Chia seeds produce a gel, which have a great potential in the development of food products as thickener, emulsifier and stabilizer [4]. It has been claimed that Chia seeds are one of the healthiest foods on the planet, packed with nutrients and health benefits for human body and brain. Health benefits of Chia seeds include supporting the digestive system, promoting healthy skin, stronger bones and muscles, reducing the risk of heart disease, diabetes and signs of aging [3,5], and so on.

In the scientific community, Chia seed research gains a momentum in the recent years and have been discovered many new and exciting things regarding its nutritional properties, phytochemicals and transcripts associated to triacylglycerol biosynthetic pathway. The findings in these perspectives have been discussed briefly in this review.

### Nutritional properties

The small Chia seeds contain full of important nutrients. Besides, maize, amaranth and beans, Chia seed was an important staple food of pre-Columbian Central America [5]. Due to the superior nutritional quality of seeds, Chia is re-discovered as crop recently. It has now been cultivated in many countries, including Mexico, America, Canada, Chile, Australia, New Zealand and Southeast Asia for different purposes, and consumed worldwide as ingredients of various food products [2]. Chia seeds consumption is also permitted and deregulated

by The United States Food and Drug Administration (FDA). The nutritional properties of Chia seeds have investigated extensively, and the works recently been reviewed in several articles [3,5,6]. It contains high amount of lipids (40%), of which 60% is omega-3 fatty acids [7]. Omega-3 fatty acids help to raise high-density lipoprotein (HDL) in human, which protects from heart attack and stroke [3]. Besides, Chia seed also contains protein of high biological value (15-25%), carbohydrates (26-41%), fiber (18-30%), ash (4-5%) [6], along with high amount of vitamins, minerals, and antioxidants [5]. As per the information in National Nutrient Database of USDA [8], 28 gram of chia seed contains protein (5.6g), fat (8.4g), carbohydrate (13.07g), fiber (11.2g) and 131 calories of energy without sugar constituent.

### Phytochemical analysis

The tiny Chia seeds are very rich in various important chemical components. In recent years, extensive research on phytochemical of Chia seeds have done, and reported various active ingredients including essential fatty acids and phenolic compounds. Out of all known food sources, chia contains the highest amount of these fatty acids, which contains about 64 % ω-3 and 19 % ω-6 fatty acids [3]. The dry Chia seed contains 8.8% of phenolic content, which was correlated with the presence of high level of caffeic acid, chlorogenic acid and quercetin [9]. In an analysis, Rahman et al. [10] reported that rosmarinic acid and daidzein were the major phenolics present in chia seed along with the presence of myricetin, quercetin, kaemferol, caffeic acid, flavonol glycosides and chlorogenic acid. In the same study, procyanidin dimers (A, B1, B2 and B3) were identified in Chia seeds for the first time. Quercetin, chlorogenic acid, caffeic acid of Chia seeds is demonstrated to have anti-carcinogenic, antihypertensive, neuron protective effects [5]. Recently, chemical and antioxidant properties of Chia seeds were reviewed by Sargi et al. [7], Segura-Campos et al. [6]. Nadeem et al. [11,12] described that the free radical scavenging activity of Chia seed is greater than *Moringa oleifera* and *Sesamum indicum.*

### Genomics research

Genomics research on Chia has started very recently, because of which there is little information available in biological databases. In a diploid cell, total chromosome number of Chia is 12 [13]. The chloroplast rbcL gene for rubisco, partial sequence of the large subunit, was the first reported gene from Chia with publically available nucleic acid sequence (GenBank id, Z37442.1). A great advancement of Chia seed genomics was done recently by comprehensive analysis of global transcriptome profile of developing seeds at five different stages (3, 7, 14, 21 and 28 days after flower opening) using Illumina platform of Next Generation sequencing technology [14]. A total of 76,014 transcripts were reported after de novo assembly of sequence data. The study revealed majority of the candidate genes, which involved in lipid biosynthesis and oil accumulation and evaluated their expression in seeds using Real Time-Quantitative Polymerase Chain Reaction (RT-qPCR). Further, 5596 numbers of simple sequence repeats (SSRs) were also reported [14]. The identified unique genes in this study of Sreedhar et al. [14], will facilitate gene discovery and pathway analysis, as well creation of genomic resources for Chia crop in future. Two full-length fatty acid desaturase 2 (EC 1.3.1.35) genes, namely ShFAD2-1 and ShFAD2-2, of Chia were also isolated using rapid amplification of cDNA ends (RACE) method [15]. The study revealed that ShFAD2-1 and ShFAD2-2 encode a bi-functional delta-12 oleate desaturase, which contain transmembrane helices, histidine motifs and C-terminal endoplasmic reticulum-located signaling amino acids (YNNKL).

## Conclusion

In the recent years, great advancement of Chia seed research has been observed in literature in regard to the nutritional properties, phytochemical analysis and genomic research. On the basis of current research findings, Chia seed contain massive nutritional and medicinal properties, for which it offers a great future potential for feed, food, medical, pharmaceutical and neutraceutical sectors. However, a detail *in vivo* and clinical studies of the safety and efficacy of this medicinal food or natural product is needed.

## Conflict of Interest

There is no conflict of interest between the authors in publishing this article.

## References


1. Da Silva MR, Moraes ÉA, Lenquiste SA, Godoy AT, Eberlin MN, et al. (2014) Chemical characterization and antioxidant potential of Chilean chia seeds and oil (Salvia hispanica L.). LWT-Food Science and Technology 59(2): 1304-1310.
2. Muñoz LA, Cobos A, Diaz O, Aguilera JM (2013) Chia seed (Salvia hispanica): an ancient grain and a new functional food. Food Reviews International 29(4): 394-408.
3. Ullah R, Nadeem M, Khalique A, Imran M, Mehmood S, et al. (2016) Nutritional and therapeutic perspectives of Chia (Salvia hispanica L.): a review. J Food Sci Technol 53(4): 1750-1758.
4. Coorey R, Tjoe A, Jayasena V (2014) Gelling Properties of Chia Seed and Flour. J Food Sci 79(5): E859-E866.
5. Ali NM, Yeap SK, Ho WY, Beh BK, Tan SW, et al. (2012) The promising future of Chia, Salvia hispanica L. J Biomed Biotechnol 2012: 171956.
6. Segura-Campos MR, Ciau-Solis N, Rosado-Rubio G, Chel-Guerrero L, Betancur-Ancona D (2014) Chemical and functional properties of chia seed (Salvia hispánica L.) gum. Int J Food Sci Nut 2014(2014): 1-5.
7. Sargi SC, Silva BC, Santos HMC, Montanher PF, Boeing JS, et al. (2013) Antioxidant capacity and chemical composition in seeds rich in omega-3: chia, flax, and perilla. Food Sci Technol (Campinas.) 33(3): 541-548.
8. https://ndb.nal.usda.gov/ndb/
9. Reyes-Caudillo E, Tecante A, Valdivia-Lopez MA (2008) Dietary fibre content and antioxidant activity of phenolic compounds present in Mexican chia (Salvia hispanica L.) seeds. Food Chem 107(2): 656- 663.
10. Rahman J, Camargo de AC, Shahidi F (2017) Phenolic and polyphenolic profiles of chia seeds and their in vitro biological activities. J Funct Foods 35: 622-634.



**How to cite this article:** Ranjana D, Akan D. Advances in Chia Seed Research. Adv Biotech & Micro. 2017; 5(2): 555661. DOI: 10.19080/AIBM.2017.05.555662.

11. Nadeem M, Abdullah M, Mahumd A, Hussain I, Inayat S (2013) Stabilization of butter oil with modified fatty acid profile by using Moringa oleifera extract as antioxidant. J Agric Sci Technol 15: 919-928.

12. Nadeem M, Situ C, Mahmud A, Khalique A, Imran M, et al. (2014) Antioxidant activity of sesame (Sesamum indicum) cake extract for the stabilization of olein based butter. J Am Oil Chem Soc 91(6): 967-977.

13. Haque MS, Ghoshal KK (1981) Floral biology and breeding system in the genus Salvia L. Proc Indian Natl Sci Acad 47(5): 716-724.

14. Sreedhar RV, Kumari P, Rupwate SD, Rajasekharan R, Srinivasan M (2015) Exploring triacylglycerol biosynthetic pathway in developing seeds of Chia (Salvia hispanica L.): a transcriptomic approach. PLoS One 10 (4): e0123580.

15. Xue Y, Yin N, Chen B, Liao F, Win AN, et al. (2017) Molecular cloning and expression analysis of two FAD2 genes from chia (Salvia hispanica). Acta Physiologiae Plantarum 39(4): 95.


DOI: 10.19080/AIBM.2017.05.555662




**How to cite this article:** Ranjana D, Akan D. Advances in Chia Seed Research. Adv Biotech & Micro. 2017; 5(2): 555661. DOI: 10.19080/AIBM.2017.05.555662.