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, kaempferol, 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
Polymerase Chain Reaction (RT-qPCR). Further, 5596 numbers evaluated their expression in seeds using Real Time-Quantitative which involved in lipid biosynthesis and oil accumulation and data. The study revealed majority of the candidate genes, transcripts were reported after de novo assembly of sequence Next Generation sequencing technology [14]. A total of 76,014 profile of developing seeds at five different stages (3, 7, 14, 21 of the large subunit, was the first reported gene from Genomics research on Chia has started very recently, 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 anticarcinogenic, 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 nutraceutical 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.

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