Original Article

Unlocking the Potential of the Science behind Health benefits of *Salvia Hispanica L.* and *Cucurbita Pepo L.* seeds: A Review

Sudhamsinh A. Solanki[1], Vaidehi Gurjar[2], Dr. Pragnesh Patani[3]

[1]Student, Khyati College of Pharmacy, Palodia, Ahmedabad.

[2]Assistant Professor, Khyati College of Pharmacy, Palodia, Ahmedabad.

[3] Principal, Khyati College of Pharmacy, Palodia, Ahmedabad.

***Corresponding Author:** Sudhamsinh A. Solanki
[*]Student, Khyati College of Pharmacy, Palodia, Ahmedabad, Email: sudhamsinhsolanki@gmail.com

Abstract:
Chia (*Salvia hispanica L.*) seeds and Pumpkin (*Cucurbita Pepo L.*) are traditional crops with high nutritional value. Herbs have been an important resource in global healthcare, offering a variety of therapeutic characteristics. Chia and Pumpkin seeds, often overlooked, are gaining popularity for their numerous health benefits and versatile applications. The novel viewpoints and possible health advantages of chia seed and pumpkin seed extracts are examined in this review. These seeds, which have historically been employed in food preparation, have drawn interest because of their high nutrient content and bioactive ingredients. Chia is valued more for its oil content because it contains a higher concentration of omega-3-alpha linolenic acid along with a variety of other nutrients, such as proteins, dietary fibers, antioxidants. Rich in fiber, protein, and minerals like calcium, iron, zinc, manganese, copper, and salt, as well as vitamin E, phytosterol, and polyunsaturated fatty acids, pumpkins may be significant for the food industry. Chia and pumpkin seeds have positive health effects on blood sugar levels, immunity, cholesterol, and weight loss. They are also excellent sources of antioxidants. These seeds offer prospective health benefits for the development of functional foods, supplements, and cosmetics products.

Keywords: Chia seed, Pumpkin seed, Health Benefits, Phytochemicals, Biological Activity.

1. INTRODUCTION

The WORD "Herb" is derived from the Latin ***HERBA***, which means "Grass/Green crops/herb or, more literally, herbage. It is this meaning of herb that Is used in Genesis, "the herb yielding seed".(1) Herbs are different parts of plants like leaves, roots, stems, barks, seeds, bulbs, and flowers that are used for various purposes such as adding flavor to food, as ingredients in cooking, for medicinal uses, and even in making perfumes.(2) Herbs have a variety of uses including botanically, culinary and medicinally. Herbs have long been used for culinary purposes, health advantages, and as preservatives.(3)

The Constitution of the World Health Organization, on April 7, 1948, defined health "as a state of complete physical, mental and social well-being." The writers of the Constitution were clearly aware of the tendency of seeing health as a state dependent on the presence or absence of diseases: so they added to that definition that an individual, if he is to be considered healthy, should not suffer from any disease.(4)

To maintain a healthy life people need nutrients. Nutrients are substances provide energy, support growth and maintenance of the body, and regulate various bodily functions. Some substances, like proteins, lipids, and carbohydrates, can be biologically broken down into smaller molecules in order

to release energy. To function, the human body must have nutrients. The nutrients known to be essential for human being are proteins, carbohydrates, fats and oils, minerals, vitamins and water.[5] Nutrients are chemical components necessary by the body to support basic processes and are best obtained by consuming a balanced diet. Carbohydrates, fats, and proteins are macronutrients that provide energy. Vitamins and minerals are micronutrients that play important roles in metabolism. Vitamins are organic micronutrients classified as either water-soluble or fat-soluble. The essential water-soluble vitamins include vitamins B1, B2, B3, B5, B6, B7, B9, B12, and C. The essential fat-soluble vitamins include vitamins A, E, D, and K. Minerals are inorganic micronutrients. Minerals can be classified as macrominerals or microminerals. [6]

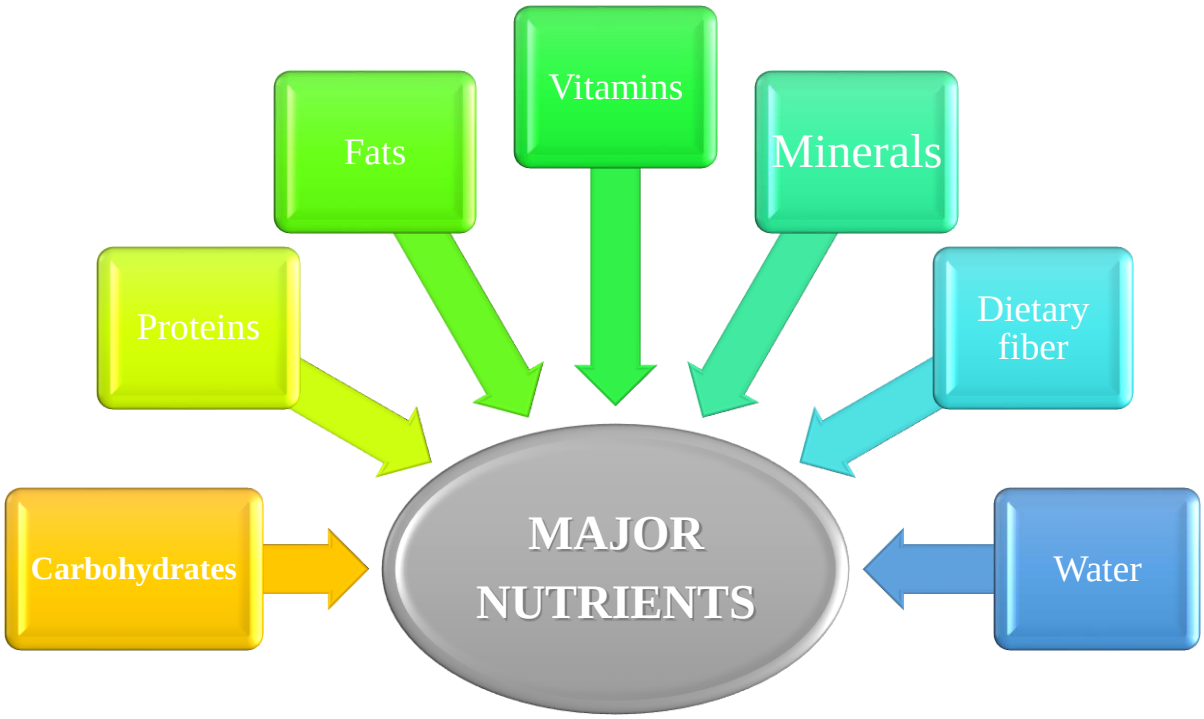


Figure 1: Major Nutrients

The Key Function of Nutrients:
1. Energy production
2. Growth and development
3. Immune function
4. Cell maintenance and repair
5. Regulation of bodily functions

The health benefits of chia seed (*Salvia Hispanica L*. seed) including heart health, digestive health, bone health, weight management, and blood sugar regulation. This seed is noted for its high nutritional content and functional properties.[8] Pumpkin seed (*Cucurbita Pepo L.* seed) health benefits including heart health, sleep support, digestive health, anti-inflammatory property, bone health, blood sugar control, prostate health. Seeds are full of nutritional powerhouses wrapped in very small packages. They are a great source of fiber, proteins, minerals, vitamins and life- enhancing nutrient. The Spanish term "chia" is a borrowing from *Nahuatl*, the language of the Aztecs, and means "oily" in plural. *Chian* is also called *chien*. The Swedish botanist Karl Linnaeus is credited with coining the term "chia". *Chiapan*, which means "River of Chia" in *Nahuatl,* was named for this plant, which has long been cultivated along the banks of the Grijalva River. These territories now make up the Mexican state of Chiapas. [9]

2. Literature Review

1. Chia Seed (*Salvia Hispanica L.)*

Figure 2.1: Chia Plant

Taxonomical Classification:[9]

- Kingdom : Plantae
- Subkingdom : Tracheobionta
- Superdivision : Spermatophyta
- Division : Magnoloiphyta
- Class : Magnoliopsida
- Subclass : Asteridae
- Order : Lamiales
- Family : *Lamiaceae*
- Genus : *Salvia*
- Species : *hispanica*

Vernacular Names (Indian Local Name):

- Sanskrit : ---
- Hindi : ---
- Gujarati : ---
- English : Chia

Plant Description:

Chia (*Salvia Hispanica L.*) is an annual herbaceous plant that belongs to the *Lamiaceae* family and genus *Salvia* (sage). [11] This plant is native from southern Mexico and northern Guatemala, which currently gaining popularity. Scientists refer to chia seeds as the "golden seeds of the 21st century." [12] Salvia is a genus of over 900 species found globally, including North, Central, and South America, South Africa, Southeast Asia, and Europe. [11] The largest production centre for chia seeds is in Mexico and Bolivia, from where the seeds are exported mainly to Japan, USA and Europe.[12] *Salvia hispanica L.* (chia) is a highly valued and commonly used *Salvia* species. This species provides seed (*Salviae hispanicae semen*) as a raw material. [11] The plant is about a meter tall and has opposite, petiolate, serrated leave measuring 4 to 8 cm in length and 3 to 5 cm in width. The flowers are hermaphrodite (Figure 2.2) and develop in dense clusters on a spike protected by tiny bracts with long, pointed points. The seeds are round, smooth, and shiny, and are mottle-colored with brown, grey, dark red, and white. They are usually found in groups of four. [9]

Figure 2: Morphological appearance of Chia Seeds

Table 1. Morphological Characteristics of Chia Plant[19]

Sr.no	Morphology	Description
1	Height	1m
2	Nature of leaf	Reverse petiolate
3	Size of leaf	4–8 cm long; 3–5 cm wide
4	Nature of flower	White or violet color, hermaphrodite
5	Size of flower	3-4 mm
6	Origin of flower	whorls on top of shoots
7	Nature of soil	Clay and sandy soils
8	Optimal weather	warm weather, high rainfall
9	Optimal temperatures	15-30°C
10	Fruits	schizocarps
11	Yield	500–600 kg seed/acre or 2500 kg/acre if proper agronomic conditions are maintained

The seeds are oval-shaped and 1-2 mm in length. They can appear homogeneous, blended, or speckled. Their hue ranges from white to gray to black. This species thrives in tropical and subtropical climates, particularly in mountainous regions. The plant grows well in sandy loam, loam, and loam soils with adequate drainage. It thrives on acidic soils and prefers a pH of 6.5- 8.5. Seeds grow best at temperatures ranging from 11 to 36 ^{o}C. Under ideal agroclimatic circumstances, the plant may generate approximately 600 kg seeds per acre. Data from 2014 showed that 370,000 hectares in 33 countries were used for S. hispanica artificial agriculture worldwide. [11]

Figure 2.2 : Chia Flower

It is rich in omega fatty acids (both omega 3 and omega 6), dietary fibers, calcium, antioxidants, iron, potassium and as well as protein. Health benefits of chia seeds are aids in reducing inflammation, promotes proper digestion, balances blood sugar levels, aids in weight loss, balances cholesterol levels, supports healthy bones, lowers cardiovascular disease risks and enhances detoxification. [8]

Nutrients in Chia Seed (*Salvia Hispanica L.)*

Chia seed is known as a complete food due to its high nutritional value, i.e., protein, carbohydrates, vitamins, minerals, lipids, dietary fiber and source of omega-3. [9] The caloric value of 100 grams of dry chia seeds is 486 kcal. Chia seeds are high in fat (30-33%), protein (15-25%), carbs (26-41%), fiber (18-30%), vitamins (A, E, C, B1, B2, B3), and minerals (calcium, phosphorus, potassium, magnesium). The seeds included important secondary metabolites, including polyphenolic compounds: Phenolic acids and flavonoids. [12]

Table 2: Nutritional Composition of Chia Seeds [9]

Sr.no.	Nutrients	100 g	1 portion (25g)
1	Energy (Kcal.)	486	121.5
2	Proteins (g)	16.54	4.14
3	Total fat (g)	30.74	7.69
4	Fatty acids, total saturated	3.33	0.83
5	Fatty acids, total monounsaturated (g)	2.309	0.58
6	Fatty acids, total polyunsaturated (g)	23.67	5.92
7	Fatty acids Trans	0.14	0.04
8	Fatty acids Omega-3 (g)	17.83	4.46
9	Cholesterol (mg)	0	0
10	Carbohydrate (g)	42.12	10.53
11	Fiber, total dietary (g)	34.4	8.6

Chia, also known as Salvia hispanica L., is an oil seed with significant nutritional content. Chia seed's chemical composition and nutritional value varies based on species, climate, production location, and soil type. The main components include lipids, dietary fibers, and proteins. Chia contains a high concentration of proteins, which are needed for the body. [15] Chia seed protein content varies between 16% and 26%, depending on growing circumstances, temperature, and humidity levels. Chia seeds grown at low temperatures and high elevations exhibit lower protein content. [12] Chia seed protein has four distinct fractions, with globulins accounting for 52% of the total protein fractions. Albumins, glutelins, and prolamins are found in nearly equal proportions. These proteins are easily digested, produce good foaming, and have great water and oil holding capabilities. Chia seed proteins contain all essential amino acids, with a high concentration of glutamic acid, arginine, and aspartic acid. [16] Table 2 compares the protein composition of chia seeds to other regularly consumed cereals.

Table 3. Comparison Between Chia Seed and Cereals [9]

Sr.no	Grain	% of Proteins
1	Rice	6.50
2	Barley	12.48
3	Oats	16.89
4	Wheat	13.68
5	Corn	9.42
6	**Chia**	**20.70**

Chia seed oil contains a high concentration of polyunsaturated fatty acids (PUFA), including over 60% α-linoleic acid and over 20% linoleic acid. Fats and oils are classified differently based on seed structure.[17]

Table 4. Proximate Composition of Chia Seeds [17]

Country of origin	Protein	Fat	Carbohydrate	Dietary fiber
India	15-23	25-34	37-45	23-35
Ecuador, Brazil	20-24	16-33	-	27-36
Salta, Argentina	15-25	30-33	26-41	18-30

The protein content of chia seeds has been fully described by the USDA. Research has demonstrated that chia seeds are a complete source of both non-essential and essential amino acids.[12]

Table 5. Essential Amino Acids Content of Chia Seeds[12]

Sr.no	Amino acids	Content acc. To USDA (g/100 g d.m.)
1	Arginine(Arg)	2.14
2	Leucine(Leu)	1.37
3	Phenylalanine (Phe)	1.02
4	Lysine(Lys)	0.97
5	Valine(Val)	0.95
6	Isoleucine(Ileu)	0.80
7	Threonine(Thr)	0.71
8	Methionine(Met)	0.59
9	Histidine (His)	0.53
10	Tryptophan(Trp)	0.44

Table 6. Nonessential Amino Acids Content of Chia Seeds[12]

Sr.no	Amino acids	Content acc. To USDA (g/100 g d.m.)
1	Glutamic acid(Glu)	3.50
2	Aspartic acid(Asp)	1.69
3	Serine(Ser)	1.05
4	Alanine(Ala)	1.04
5	Glycine(Gly)	0.94
6	Proline(Pro)	0.78
7	Tyrosine(Tyr)	0.56
8	Cysteine(Cys)	0.41

Table 7. Proximate Chemical Composition (%) of Chia Seed[18]

Sr.no	Chemical composition	Mean ± Standard deviation
1	Moisture	7.82 ±0.06
2	Ash	4.77 ±4.77
3	Crude protein	18.65 ±0.06
4	Total lipids	35.80 ±0.15
5	Crude fibre	22.78 ±0.98

Chia is an excellent source of B vitamins. Compared to other cereals, the seed has more niacin than corn, soybeans, and rice. The thiamine and riboflavin content is comparable to rice and corn. [9]

Table 8. Vitamins Content [9]

Sr.no	Vitamins	Units	Quantity
1	Vitamin C (total ascorbic acid)	mg	1.6
2	Thiamine	mg	0.62
3	Riboflavin	mg	0.17
4	Niacin	mg	8.83
5	Folate	µg	49
6	Vitamin A	IU	54
7	Vitamin E (alpha-tocopherol)	mg	0.5

IU: International unit

Chia is a rich source of minerals, with six times more calcium, eleven times more phosphorus, and four times more potassium than 100 g of milk. It also includes magnesium, iron, zinc, and copper. [9]

Table 9. Evaluation of Mineral Content in Chia Seed[18]

Sr.no	Minerals/100g	Amount present (mg)
1	Calcium	631
2	Iron	7.72
3	Magnesium	335
4	Phosphorus	860
5	Potassium	407
6	Sodium	16
7	Zinc	4.58
8	Copper	0.11
9	Chromium	9.53
10	Arsenic	0.16
11	Nickel	0.19

Bioactive Compounds/ Phytoconstituents in Chia Seed

Chia seeds contain several active and phenolic components, as well as essential fatty acids. The active components are Myricetin, Kaempferol, Quercetin, Caffeic acid, Omega-3, and Omega-6. The concentrations of these active chemicals may vary depending on cultivation area. Phytochemical composition is influenced by environmental factors such as climate, nutrient availability, culture year, and soil conditions. Chia seeds contain a high fat content (30-33%), proteins (15-25%), dietary fiber (18-30%), carbs (26-41%), vitamins, antioxidants and minerals.[22] Chia has good nutritional content and prospective bioactive substances for human health, yet its nutritional composition varies by growth conditions. Chia seed has a low carbohydrate content (3.4%), but a high protein (18.9%) and fat (31.2%) composition. Alpha-linolenic (omega-3 orn-3) (19.5%) and alpha-linoleic acids (omega-6 or n-6) (5.2%) are important nutrients that humans cannot generate.[20] The seeds contain phenolic acids, with rosmarinic acid (from 65.4 to 92.7 mg/100 g d.m.), caffeic acid (from traces to 12.5 mg/100 g d.m.), chlorogenic acid (from 0.5 to 10.2 mg/100 g d.m.), ferulic acid (from traces to 3.6mg/100 g d.m.), p-coumaric acid (from 0.02 to 2.6 mg/100 g d.m.), and gallic acid (from 0.3to 12.5mg/100 g d.m.).[12]

Chia seed intake has increased due to its nutritional value in Ω-3 PUFA, dietary fiber, and high quality proteins. Chia seeds' high protein and necessary AA content have also been shown to be a promising source of bioactive peptides. Chia seed protein is well-known for its antioxidant, antihypertensive, and anti-inflammatory effects. [21] Chia-derived peptides have been shown to be effective as ACE and DPP-IV inhibitors, as well as antioxidants. Thus reinforcing the health benefits of chia for its hypotensive, hypocholesterolemic, hypoglycemic, and antioxidant potential.[21]

Chia seeds are rich in polyunsaturated fatty acids (PUFA) and dietary fiber, making them highly nutritious.[11] Oil derived from *S. hispanica* seeds contains 30-33% fatty acids, with 80% essential fatty acids (EFAs), particularly PUFA. The major fatty acids in the oil are ALA, an omega-3 fatty acid that accounts for roughly 60% of the fatty acid pool, and linoleic acid (LA), an omega-6 fatty acid that accounts for approximately 20% of the oil. Chia seeds have a very favorable omega-6 to omega-3 fatty acid ratio (between 0.3 and 0.35). Monounsaturated fatty acids, known as omega-9 fatty acids, account for approximately 10% of the fatty acid pool in chia seeds, with oleic acid dominating. Saturated fatty acids, primarily palmitic and stearic acid, make up the remaining 10% of the fatty acid pool. Chia seeds contain the most ALA when compared to raw materials derived from other plant species. Unfortunately, the high level of PUFA (80%) in chia seeds renders them prone to oxidation processes, which reduce the nutritional value of the seeds.[11]

Table 10. Phytoconstituents of *Salvia Hispanica L.* (Chia Seed)[22, 11]

Part	Constituents
Seeds	Flavonoids : Myricetin, Quercetin, Kaempferol Caffeic acids derivatives : Caffeic acids, Chlorogenic acid, Rosmarinic acid, and Ferulic acid Protein, Carbohydrates, Vitamins, Amino acids- arginine, isoleucine, leucine, Glutamic acid. .Mineral composition- Na, Ca, Mg, Iron, Zinc
Seed oil	Polyunsaturated fatty acids, omega-3 fatty acid, linoleic acid, oleic acid, palmitic and stearic acid.

Pharmacological/ Biological Activity

Antihypertensive Activity :

Chia seed contains peptides from prolamin and globulin fractions that effectively chelate ferrous ions, indicating anti-hypertensive effects. Chia protein can effectively treat hypertension.[19] Chia seed is recommended for patients with hypertension. Omega-3 fatty acids have been associated with lower blood pressure levels. Chia seeds have been found to have antihypertensive effects using enzymatic research.[22]

Hypertension (high blood pressure) is a significant risk factor. Some research have revealed that chia seeds have a promising ability to lower blood pressure. For hypertensive people, consuming 35 g/day of chia flour for three months lowered blood pressure, lipid peroxidation, and plasma nitrite levels. Chia has high levels of n-3 fatty acids, which have antioxidant and anti-inflammatory properties.[20]

Antioxidant Potential :

Oxidative stress is linked to lifestyle disorders like diabetes, cardiovascular disease, and cancer. Chia seeds have high levels of EFAs, polyphenolic compounds, and proteins, which contribute to their antioxidant effect. The antioxidant capabilities of peptides isolated from chia seeds were investigated, and it was discovered that proteins found in chia seeds, such as albumin, glutelin, and globulin, had the maximum activity.[12]

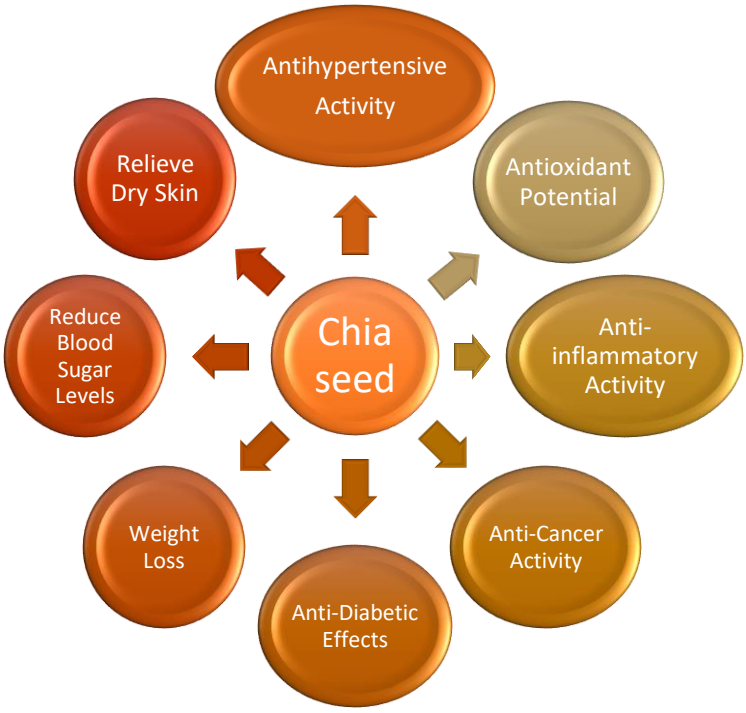


Figure 2.3 : Various benefits of consumption of Chia seeds on the health and well-being of humans

Improving Gastrointestinal Function :
Soluble extracts from fiber-rich plants, such as chia seeds, can improve gastrointestinal motility by increasing vitamin and mineral absorption. Plant extracts can improve mineral absorption, particularly the bioavailability of zinc and iron.[12]

Anti-inflammatory Activity :
Inflammation is the body's natural response to injuries and diseases. Inflammation can assist the body fight harmful infections, but it can also cause injury. Chronic inflammation is a risk factor for cancer and heart disease. Chia seeds have anti-inflammatory properties and can reduce edemas induced by croton and carrageenan oil. Flavonoids like myricetin and quercetin have anti-inflammatory properties. Flavonoids' anti-inflammatory properties reduce cytokine production during inflammation. Cytokines such as interleukin-12 and interleukin-1β are produced via regulating transcription and mediators. Flavonoids can reduce inflammation by inhibiting kinases and TNF-alpha action.[22]

Anticancer Activities:
Vegetable oils from Salvia hispanica (ChO) and Carthamus tinctorius (SaO) were used as sources of ω-3 and -6 PUFAs, with a commercial diet serving as a control. We analyzed fatty acids in NC membranes using GLC, eicosanoids 12-HETE and 12-HHT (LOX and COX metabolites) using HPLC, and apoptosis and T-lymphocyte infiltration using flow cytometry and microscopy. NC from the ChO group had significantly lower levels of arachidonic acid and eicosanoids compared to SaO and CO ($p<0.05$). The ChO diet reduced tumor weight and metastatic numbers ($p<0.05$). Higher apoptosis and T-lymphocyte infiltration were observed, although mitosis decreased compared to other diets ($p<0.05$). [19]

Weight Loss:
Chia seeds have a higher percentage of protein content. Soluble fiber and mucilage absorb water, causing seeds to expand in the stomach and provide longer-lasting fullness, leading to less food consumption. In this method, Chia seeds help people maintain or lose weight.[22]

Reduce Blood Sugar Levels :
Untreated type 2 diabetes can cause high fasting blood sugar levels and raise the risk of chronic conditions including heart disease. Human studies have shown that eating bread with chia seeds lowers the rise in blood sugar after a meal compared to bread without chia seeds. Chia seeds after a high-carb meal may lower the risk of high blood sugar, which is beneficial for those with type 2 diabetes. [22]

Relieve Dry Skin :
Healthy skin has a layer of lipids, known as stratum lucidum, that lock in moisture and keep it hydrated. Insufficient lipids in the skin layer can cause moisture loss and dryness. Chia seed oil contains omega-6 fatty acids, linoleic acid, and the omega-fatty acid ALA. These two fatty acids are proven to aid in reinstalling the skin's moisture barrier, particularly for people with dry skin diseases including psoriasis and atopic dermatitis. [22]

2. Pumpkin seed (*Cucurbita Pepo L.)*

Figure 2.4: Pumpkin Plant and Flower

Taxonomical Classification: [10]
- Kingdom : Plantae
- Division : Spermatophyta
- Sub-Division : Angiospermae
- Class : Dicotyledonae
- Sub-class : Poly patella
- Series : Caliciflorae
- Order : Passiflorales
- Family : *Cucurbitaceae*
- Genus : *Cucurbita*
- Species : maximus

Vernacular Names (Indian Local Name) :[24]
- Sanskrit : Dangari, Kushmanda, Pitaphala
- Hindi : Kadu, Jangli Kaddu
- Gujarati : Koron
- English : Pumpkin, Melon

Plant Description:

Pumpkin is a member of the *Cucurbitaceae* family and genus *Cucurbita*.[25] Pumpkin cultivation has spread to Europe (France and Portugal), Asia (India and China), and Western America, with origins in northern Mexico, Argentina, and Chile. Pumpkins are an annual vine or trailing plant that can be grown from sea level to high altitude. It is known for its tasty seeds, fruit, and greens.[26] Pumpkin (Cucurbita spp.) is a useful vegetable with over 130 genera and 800 species.[27]

Cucurbita, the most economically significant genus, consists of five species: *C. maxima*, *C. pepo*, *C. moschata, C. ficifolia*, and *C. turbaniformis*. *C. pepo* is the most diverse, particularly in fruit features.[28] Their color varies from lemon yellow to dark orange. The sepals range in length from 1 to 3 cm and are free. The corolla is campanulate, with widely spaced lobes. Male flowers have pedicels that can be up to 16 cm long.[29]

Figure 2.5 : Morphological appearance of Pumpkin Seed

The seeds are ovoid and flattened. The seeds are 1-2 cm long and 0.5-1 cm wide. The seeds may be white, tan, or black. The surface of the seeds might be smooth or rough. Seedlings germinate epigeously. The cotyledons are elliptical and range in length from 2 to 4 cm. [29] Pumpkin seeds are a good source of zinc. It boosts immunological function and promotes cell proliferation.[8] Pumpkins are believed to have originated in Guetmala, Central Mexico, or Columbia based on their seed color. The name pumpkin comes from the Greek word Pepon, which means huge melon.[31]

Nutrients in Pumpkin Seed (*Cucurbita Pepo L.*)

Pumpkin seeds are a nutritional powerhouse, rich in minerals such as zinc, phosphorous, magnesium, potassium, and selenium, which help fight diseases like arthritis, inflammation, and prostate cancer.[30] Pumpkin is a rich source of nutrients essential for human health. *C.pepo* seeds were found to have 0.005-0.013 mg kg^{-1} iodine (I), while pumpkin seed oil contained 0.002-0.003 mg kg^{-1}. [32]

Table 11. Nutritional Composition of Pumpkin Seed (* Nutritional value per 100 g) [30]

Sr.no	Nutrients	Nutrient Value	Percentage of RDA
1	Energy	559 Kcal	28%
2	Carbohydrates	10.71 g	8%
3	Protein	30.23 g	54%
4	Total Fat	49.05 g	164%
5	Cholesterol	0 mg	0%
6	Dietary Fiber	6 g	16%
Electrolytes			
7	Sodium	7 mg	0.5%
8	Potassium	809 mg	17%
Phyto-nutrients			
9	Carotene-β	9 µg	--
10	Crypto-xanthin-β	1 µg	--
11	Lutein-zeaxanthin	74 µg	--

Table 12. Amino Acids (mg/g dry weight) Profiles of Pumpkin Seed [26]

Sr.no	Amino Acids	Amount
1	Alanine	23.4
2	Arginine	93.2
3	Aspartic acid	52.8
4	Cysteine	6.73
5	Glutamic acid	104
6	Glycine	28.3
7	Histidine	13.8
8	Isoleucine	23.0
9	Leucine	40.9
10	Lysine	22.0
11	Methionine	12.4
12	Phenylalanine	31.4
13	Proline	20.2
14	Serine	31.7
15	Threonine	18.4
16	Tryptophan	15.3
17	Tyrosine	22.1
18	Valine	28.2

Table 13. Vitamin Composition of the Pumpkin Seeds per 100g [34]

Sr.no	Vitamins (Micronutrients)	Amount
1	B_9 (Folic acid)	58 µg
2	B_3 (Niacin)	4.8 mg
3	B_5	0.75 mg
4	B_6	0.14 mg
5	B_2	0.15 mg
6	B_1 (Thiamin)	0.272 mg
7	Vitamin C	0.272 mg
8	Vitamin A	16 IU
9	Vitamin E	35.1 mg

IU : International unit

Table 14. Mineral Composition of Pumpkin Seed [33]

Sr.no	Minerals	Mean value (mg/100g)
1	Iron (Fe)	16.1
2	Manganese (Mn)	487
3	Zinc (Zn)	907
4	Copper (Cu)	124
5	Phosphorus (P)	848.6
6	Potassium (K)	404.9
7	Calcium (Ca)	25.7
8	Magnesium (Mg)	335.6
9	Sodium (Na)	2.2
10	Cobalt (Co)	0.6

Table 15. Fatty Acid Profiles of Pumpkin Seed [33]

Sr.no	Fatty acid	Mean value (%)
1	Palmitic Acid	17.63
2	Palmitolic Acid	0.33
3	Stearic Acid	14.96
4	Oleic Acid	27.75
5	Linoleic Acid	37.89
6	Linolinic Acid	0.18
7	Arachidic Acid	0.30
8	Behenic Acid	0.21
9	Eursic acid	0.21

Bioactive Compounds/ Phytoconstituents in Pumpkin Seed

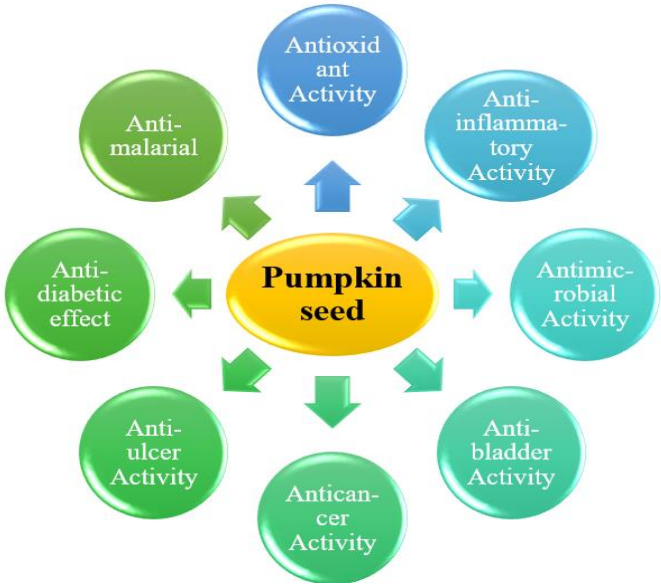
Pumpkins are high in key vitamins and minerals, making them ideal for preventing the COVID-19 pandemic through proper eating. Fresh pumpkin sprouts are rich in antioxidants and phytonutrients. Pumpkin leaves, blossoms, seeds, and pulp all include antioxidants, which are chemicals with a high biological activity. Antioxidants protect against free radicals and reactive oxygen species, lowering the risk of cancer, cardiovascular disease, and neurological illnesses.[35]

Pumpkin's health benefits stem from its biologically active components, including polysaccharides, para-aminobenzoic acid, fixed oils, sterols, proteins, and peptides. The fruits are rich in carotenoids and γ-aminobutyric acid. Pumpkin seeds (Cucurbita spp.) are abundant in protein and contain important fatty acids, including linoleic acid. Pumpkin seeds have extremely high levels of critical amino acids. Pumpkin seeds also contain a significant number of important microelements such as K, Cr, and Na. Pumpkin seeds have high levels of magnesium, zinc, copper, molybdenum, and selenium.[26]

Pumpkin peel, meat, and seeds contain high levels of phenolics, flavonoids, carotenoids, and minerals. Pumpkin contains numerous health-promoting compounds and minerals. Pumpkin polysaccharides act as antioxidants. [35]

Pumpkin plant fruit pulp contains hypoglycaemic polysaccharides. Pumpkin plant sections contain diverse antibacterial and antifungal components. Anti-fungal proteins include α and β-moschins (MW 12kDa) and MAP-28 (MW 28kDa).[26]

Pharmacological/ Biological Activity



Antioxidant Activity:
Oxidation is a pathological situation characterized by the formation of reactive oxygen and nitrogen species that interact with biological components such as deoxyribonucleic acid and protein. This can lead to inflammation and metabolic disorders. Pumpkin fruit has been identified as a useful antioxidant meal. *In vitro* analysis of phosphorylated pumpkin derivatives for antioxidant properties revealed a positive connection with the parent material.(27)

Antimicrobial Activity:
Pumpkin has antibacterial properties that could be used in medicine, pharmaceuticals, and the food industry. Ethyl acetate derived from *C. pepo* leaves had antimicrobial action against bacteria such as *Providencia stuartii*, *Pseudomonas aeruginosa, Klebsiella pneumoniae, E. coli, Enterobacter aerogenes*, and *Enterobacter cloacae.*(27)

Anti-Ulcer activity:
Peptic ulcer is due to a wound in the gastric or duodenal mucosa. Pulp of *C. pepo* is rich in vitamin C and used to treat jaundice, enteritis, dyspepsia, and stomach disorders. *C. pepo* pulp has gastroduodenal protective and anti-ulcer properties.(27)

Anti-Diabetic Effects:
It has been determined that oil of pumpkin seeds food regimen decrease the elevated level of the enzymes alanine aminotransferase (ALT) in plasma and aspartate aminotransferase that reverse the risks of diabetes occurrence. It is consumed in normal food may be useful for the diabetes prevention.(34)

Anti-Bladder Stone Activity:
Gallbladder stone is a frequent health problem, particularly in the developed countries. Pumpkin seed snacks exhibit significant anti-bladder stone activity by diminishing crystal formation which reduces the risk of bladder stones. Pumpkin seed oil reduces bladder and urethral pressures and increases bladder compliance. Intake of vitamin C, calcium, vegetable protein, and fiber in pumpkin seed has potential for management of gallbladder stones.(27)

Antimalarial Activity:
A plasmodium is a type of specialized bacterium that causes malaria. In impacted areas, a Significant portion of the population receives therapy from natural remedies. It is thought that the crude ethanolic extract of C. maxima can help stop parasitemia from developing in vivo. Pyrimethamine and crude ethanolic extract from C. maxima were used to boost immunity against malaria. C. maxima leaf extracts have larvicidal and ovicidal qualities, making them useful as a barrier to prevent mosquito bites.(27)

3. Conclusion:
As new information about lesser-known sources like chia and pumpkin seeds becomes available, the role of herbs in promoting health and well-being is changing. Seeds, which are sometimes disregarded, have shown potential in health and nutrition, providing useful insights into herbal therapies.
Chia seeds are high in protein, fiber, fats, vitamins, minerals, and antioxidants. It is also effective in the treatment of various disorders due to its oil content (omega-3 ALA).
Chia has the potential to prevent diseases such as CVS, arthritis, and promote overall health. Minerals such as Fe, Mg, Mn, Zn, Cu, Ca, Na, and K are abundantly present.
Protein and carbohydrate levels are also high. Chia crops include significant levels of phenols, flavonoids, and antioxidants, making them highly beneficial for health.

Pumpkin seeds have significant nutritional content, provide high-quality oil, and are a great source of protein. These bioactive substances, including phenolics, tocopherols, and carotenoids, offer nutritional and therapeutic benefits while also protecting against oxidative stress. Pumpkin is an edible food that may be added to our regular diets to provide a variety of health advantages. Pumpkin offers numerous health benefits, including anti-diabetic, antioxidant, and anti-microbial properties. Other health benefits of pumpkin have been identified, including the prevention of kidney stone development, hypotensive and anti-inflammatory properties.
Adding chia and pumpkin seeds to your diet can provide both flavor and nutrition. Consultation with healthcare specialists or nutritionists is recommended to correspond with individual health objectives and needs.

4. Reference:

1. Tucker AO, DeBaggio T. *The encyclopedia of herbs: A comprehensive reference to herbs of flavor and fragrance.* Timber Press; **2009**:(23).
2. Parkash J, Prasad DN, Shahnaz M, Dev D. "Herbs as traditional medicines: a review" *Journal of drug delivery and therapeutics*.**2018** Sep 12; 8(5):146-50.
3. Tapsell LC, Hemphill I, Cobiac L, Sullivan DR, Fenech M, Patch CS, Roodenrys S, Keogh JB, Clifton PM, Williams PG, Fazio VA. "Health benefits of herbs and spices: the past, the present, the future"**, 2006**; 185(4): S4–24.
4. Sartorius N. "The meanings of health and its promotion." *Croatian Medical Journal*. **2006** Aug; 47(4):662-64.
5. Fredrick A. "Textbook of food and nutrition." Lotus Press**: 2006**;1-263.
6. Morris, Alyssa L., and Shamim S. Mohiuddin. "Biochemistry, nutrients." **(2020).**
7. Callahan D. " The WHO definition of 'health'." *Hastings Center Studies*. **1973** Jan 1:77-87.
8. Mandal M, Mishra S. "NUTRITIONAL VALUE OF PRODUCT AND ITS ENRICHMENT USING SUPER SEEDS (PUMPKIN SEEDS, CHIA SEEDS, SUNFLOWER SEEDS AND ALMOND) IN APPLICATION OF READY TO EAT UPMA." *Annals: Food Science & Technology*. **2020** Jan 1;21(1).
9. Hernandez LM. *Mucilage from chia seeds (Salvia hispanica): Microestructure, physico-chemical characterization and applications in food industry*. Pontificia Universidad Catolica de Chile (Chile); **2012**.
10. Kaur S, Panghal A, Garg MK, Mann S, Khatkar SK, Sharma P, Chhikara N. "Functional and nutraceutical properties of pumpkin–a review." *Nutrition & Food Science.* **2020** Mar 5;50(2):384-401.
11. Motyka S, Koc K, Ekiert H, Blicharska E, Czarnek K, Szopa A. "The current state of knowledge on Salvia hispanica and Salviae hispanicae semen (chia seeds)." *Molecules.* **2022** Feb 11;27(4):1207.
12. Motyka S, Skała E, Ekiert H, Szopa A. "Health-promoting approaches of the use of chia seeds." *Journal of Functional Foods*. **2023** Apr 1;103:105480.
13. da Silva Marineli R, Moraes ÉA, Lenquiste SA, Godoy AT, Eberlin MN, Maróstica Jr MR. "Chemical characterization and antioxidant potential of Chilean chia seeds and oil (Salvia hispanica L.)." *LWT-Food Science and Technology*. **2014** Dec 1;59(2):1304-10.
14. Gebremeskal YH, Nadtochii LA, Chernykh TF, Siddique HR. "BIOLOGICAL ACTIVESUBSTANCES BASED ON CHIA SEEDS (SALVIA HISPANICA L.);"137-146.
15. Da Silva BP, Dias DM, de Castro Moreira ME, Toledo RC, da Matta SL, Lucia CM, Martino HS, Pinheiro-Sant'Ana HM. "Chia seed shows good protein quality, hypoglycemic effect and improves the lipid profile and liver and intestinal morphology of Wistar rats." *Plant Foods for Human Nutrition*. **2016** Sep;71:225-30.
16. Timilsena YP, Wang B, Adhikari R, Adhikari B. "Preparation and characterization of chia seed protein isolate–chia seed gum complex coacervates." *Food hydrocolloids*. **2016** Jan 1;52:554-63.

17. Katunzi-Kilewela A, Kaale LD, Kibazohi O, Rweyemamu LM. "Nutritional, health benefits and usage of chia seeds (Salvia hispanica): A review." *African Journal of Food Science*. **2021** Feb 28;15(2):48-59.
18. Rubavathi S, Ayyappadasan G, Sangeetha N, Harini T, Saranya D, Harshapradha P. "Studies on antioxidant and anti-obesity activity of Salvia hispanica (Chia) seeds extracts." *Journal of Drug Delivery and Therapeutics*. **2020** Jun 15;10(3-s):98-106.
19. Pal D, Raj K. "Chia seed in health and disease prevention: prevent usage and future perspectives." *International Journal of Pharmaceutical Science and Research*. **2020**;4123-33.
20. Grancieri M, Martino HS, Gonzalez de Mejia E. "Chia seed (Salvia hispanica L.) as a source of proteins and bioactive peptides with health benefits: A review." *Comprehensive Reviews in Food Science and Food Safety*. **2019** Mar;18(2):480-99.
21. Rabail R, Khan MR, Mehwish HM, Rajoka MS, Lorenzo JM, Kieliszek M, Khalid AR, Shabbir MA, Aadil RM. "An overview of chia seed (Salvia hispanica L.) bioactive peptides' derivation and utilization as an emerging nutraceutical food." *Frontiers in Bioscience-Landmark*. **2021** Sep 30;26(9):643-54.
22. Nyingi Wambua, Joseph, and Monica Mburu. "Chia (Salvia hispanica L.) seeds phytochemicals, bioactive compounds, and applications: a review." (**2021**);1-12.
23. Hawaldar AS, Ballal S. "Review on antioxidant and Hemagglutination properties of chia and basil seeds." *Journal of Pharmaceutical Research International*. **2021** Apr 23;33(25B):44-52.
24. Anjum Parveen DM, Saleem N, Siddiqui AI. "A comprehensive review of Kaddu (Pumpkin) as a potent neutraceutical in Unani system of medicine";32-38.
25. Kwiri R, Winini C, Musengi A, Mudyiwa M, Nyambi C, Muredzi P, Malunga A. "Proximate composition of pumpkin gourd (Cucurbita pepo) seeds from Zimbabwe." (**2014**); 279-283.
26. Yadav M, Jain S, Tomar R, Prasad GB, Yadav H. "Medicinal and biological potential of pumpkin: an updated review." *Nutrition research reviews*. **2010** Dec;23(2):184-90.
27. Sharma P, Kaur G, Kehinde BA, Chhikara N, Panghal A, Kaur H. "Pharmacological and biomedical uses of extracts of pumpkin and its relatives and applications in the food industry: a review." *International Journal of Vegetable Science*. **2020** Jan 2;26(1):79-95.
28. Gohari AA, Farhoosh R, Haddad KM. "Chemical composition and physicochemical properties of pumpkin seeds (Cucurbita pepo Subsp. pepo Var. Styriaka) grown in Iran;"(**2011**);1053-1063.
29. Ulrich HG, Vincent E, Adam A. "Current state of knowledge on the potential and production of Cucurbita moschata (pumpkin) in Africa: A review." *African Journal of Plant Science*. **2022** Jan 31;16(1):8-21.
30. Devi NM, Prasad RV, Sagarika N. "A review on health benefits and nutritional composition of pumpkin seeds." *International journal of chemical studies.* **2018**;6(3):1154-7.
31. Dhiman AK, Sharma KD, Attri S. "Functional constitutents and processing of pumpkin: A review." *Journal of Food Science and Technology*. **2009** May;46(5):411.
32. Zhou T, Kong Q, Huang J, Dai R, Li Q. "Characterization of nutritional components and utilization of pumpkin." *Food*. **2007**;1(2):313-21.
33. Devi NM, Prasad R, Palmei G. "Physico-chemical characterisation of pumpkin seeds." *International Journal of Chemical Studies*. **2018**;6(5):828-31.
34. Syed QA, Akram M, Shukat R. "Nutritional and therapeutic importance of the pumpkin seeds." *Seed*. **2019**;21(2):15798-803.
35. Hussain A, Kausar T, Sehar S, Sarwar A, Ashraf AH, Jamil MA, Noreen S, Rafique A, Iftikhar K, Quddoos MY, Aslam J. "A Comprehensive review of functional ingredients, especially bioactive compounds present in pumpkin peel, flesh and seeds, and their health benefits." *Food Chemistry Advances***. 2022** Oct 1;1:100067.
36. Agurla V, Sharma M, Pawase PA, Shams R, Ingale OS, Dash KK. "A review on extraction, functionality and application of chia seeds as a storehouse of bioactive components." *Measurement: Food*. **2024** Jul 15:100185.

37. Prathyusha P, Kumari BA, Suneetha WJ, Srujana MN. "Chia seeds for nutritional security." *Journal of Pharmacognosy and Phytochemistry*. **2019**;8(3):2702-7.
38. Nagalla SY, Samal KC, Behera L, Sahoo JP, Mishra D, Sahoo AR, Praveena J, Nargave CS. "Morpho-quantitative and biochemical characterization of Chia (Salvia hispanica L.) seeds to understand its benefits and to increase its adaptability." *Environment Conservation Journal*. **2022** Jul 26;23(3):353-60.
39. Bushway AA, Belyea PR, Bushway RJ. "Chia seed as a source of oil, polysaccharide, and protein." *Journal of Food Science.* **1981** Sep;46(5):1349-50.
40. Rashid N, Ashraf I, Kumar R, Richa R. "Enrichment via chia seeds to tackle hidden hunger: A review." *Journal of Food Processing and Preservation*. **2021** Sep;45(9):e15593.
41. Valdivia-López MÁ, Tecante A. "Chia (Salvia hispanica): A review of native Mexican seed and its nutritional and functional properties." *Advances in food and nutrition research*. **2015** Jan 1;75:53-75.
42. Mehta J, Saeed MS, Saeed A. "Health aspects of Chia seeds (Salvia hispanica L.)-an overview." *Current Research in Agriculture and Farming*. **2020;**1(3):9-12.
43. Yedida HV, Bitra VS, Burla SV, Gudala V, Kondeti S, Vuppula RK, Jaddu S. "Hydration behavior of chia seed and spray drying of chia mucilage." *Journal of Food Processing and Preservation*. **2020** Jun;44(6):e14456.
44. Ahmad G, Khan AA. "Pumpkin: horticultural importance and its roles in various forms; a review." *Int. J. Hortic. Agric*. **2019** Feb;4(1):1-6.
45. Timilsena YP, Wang B, Adhikari R, Adhikari B. "Preparation and characterization of chia seed protein isolate–chia seed gum complex coacervates." *Food hydrocolloids*. **2016** Jan 1;52:554-63.
46. Singh A, Kumar V. "Phyto-chemical and bioactive compounds of pumpkin seed oil as affected by different extraction methods." *Food Chemistry Advances*. **2023** Oct 1;2:100211.
47. Dotto JM, Chacha JS. "The potential of pumpkin seeds as a functional food ingredient: A review." *Scientific African*. **2020** Nov 1;10:e00575.
48. Noor DA, Katmawanti S, Kurniawan A. "Pumpchees Bar Development (Pumpkin Seeds and Chia Seeds) as an Alternative High-Fiber Snack." *InInternational Conference on Sports Science and Health (ICSSH 2022*) **2022** Dec 23 (pp. 269-281). Atlantis Press.
49. Fruhwirth GO, Hermetter A. "Seeds and oil of the Styrian oil pumpkin: Components and biological activities." *European Journal of Lipid Science and Technology*. **2007** Nov;109(11):1128-40.
50. Mohd Ali N, Yeap SK, Ho WY, Beh BK, Tan SW, Tan SG. "The promising future of chia, Salvia hispanica L." *BioMed Research International*. **2012**;2012(1):171956.
51. Knez Hrnčič M, Ivanovski M, Cör D, Knez Ž. "Chia Seeds (Salvia hispanica L.): An overview—Phytochemical profile, isolation methods, and application." *Molecules*. **2019** Dec 18;25(1):11.
52. Mohd Ali N, Yeap SK, Ho WY, Beh BK, Tan SW, Tan SG. "The promising future of chia, Salvia hispanica L." *BioMed Research International.* **2012**;2012(1):171956.
53. Khalid W, Arshad MS, Aziz A, Rahim MA, Qaisrani TB, Afzal F, Ali A, Ranjha MM, Khalid MZ, Anjum FM. "Chia seeds (Salvia hispanica L.): A therapeutic weapon in metabolic disorders." *Food Science & Nutrition*. **2023** Jan;11(1):3-16.
54. Ullah R, Nadeem M, Khalique A, Imran M, Mehmood S, Javid A, Hussain J. "Nutritional and therapeutic perspectives of Chia (Salvia hispanica L.): a review." *Journal of food science and technology*. **2016** Apr;53(4):1750-8.
55. Kulczyński B, Kobus-Cisowska J, Taczanowski M, Kmiecik D, Gramza-Michałowska A. "The chemical composition and nutritional value of chia seeds—Current state of knowledge." *Nutrients*. **2019** May 31;11(6):1242.
56. Martínez-Cruz O, Paredes-López O. "Phytochemical profile and nutraceutical potential of chia seeds (Salvia hispanica L.) by ultra high performance liquid chromatography." *Journal of Chromatography A*. **2014** Jun 13;1346:43-8.

57. Marcinek K, Krejpcio Z. "Chia seeds (Salvia hispanica): health promoting properties and therapeutic applications-a review." *Roczniki Państwowego Zakładu Higieny*. **2017;**68(2).
58. Coelho MS, Salas-Mellado MD. "Chemical characterization of chia (Salvia hispanica L.) for use in food products." *Journal of Food and Nutrition Research*. **2014** May;2(5):263-9.
59. Katunzi-Kilewela A, Kaale LD, Kibazohi O, Rweyemamu LM. "Nutritional, health benefits and usage of chia seeds (Salvia hispanica): A review." *African Journal of Food Science.* **2021** Feb 28;15(2):48-59.
60. Quanhong L, Caili F. "Application of response surface methodology for extraction optimization of germinant pumpkin seeds protein." *Food chemistry*. **2005** Oct 1;92(4):701-6.
61. Mansour EH, Dworschak E, Peredi J, Lugasi A. "Evaluation of pumpkin seed (Cucurbita pepo, Kakai 35) as a new source of protein." *Acta Alimentaria-an International Journal of Food Science.* **1993**;22(1):3-14.
62. Boujemaa I, El Bernoussi S, Harhar H, Tabyaoui M. "The influence of the species on the quality, chemical composition and antioxidant activity of pumpkin seed oil." *OCL*. **2020**;27:40.
63. Xanthopoulou MN, Nomikos T, Fragopoulou E, Antonopoulou S. "Antioxidant and lipoxygenase inhibitory activities of pumpkin seed extracts." *Food Research International.* **2009** Jun 1;42(5-6):641-6.
64. Makni M, Fetoui H, Gargouri NK, Garoui EM, Zeghal N. "Antidiabetic effect of flax and pumpkin seed mixture powder: effect on hyperlipidemia and antioxidant status in alloxan diabetic rats." *Journal of Diabetes and its Complications*. **2011** Sep 1;25(5):339-45.
65. Azeem AA, Mounir AM, El-Shahat AN. "Studying the anti-diabetic effect of gamma-irradiated pumpkin seeds." *Pakistan J. Zool*. **2021**:1-7.