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Comparative Study Of Chia Seed And Tulsi Seed In The Basis Of Phytochemical

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Abstract

In this research, a comparative phytochemical profiling of Salvia hispanica (Chia seed) and Ocimum sanctum (Tulsi seed), two well-established botanicals known for their nutritional and medicinal values, is discussed. Chia seeds are all endowed with omega-3 fatty acids, dietary fiber, polyphenols, and flavonoids, which account for their antioxidant, anti-inflammatory, and cardioprotective properties. Contrarily, Tulsi seeds have a distinctive phytochemical composition, which contains eugenol, ursolic acid, and different terpenoids, mainly attributed to their adaptogenic, antimicrobial, and hepatoprotective effects.

The research compares the contents of major phytochemical classes like alkaloids, flavonoids, saponins, tannins, glycosides, and phenolic compounds in both seeds using qualitative and quantitative assays. The results indicate both shared and unique biochemical signatures validating the application of each seed in traditional and contemporary health practices. Elucidation of these differences could lead to more specific therapeutic utilization and product development in nutraceutical and pharmaceutical industries.

Introduction :

The talk of the town, or rather, "the natural plant seeds" have gained a whole lot of attention for their quotes therapeutic and nutritional properties". Among them, chia seeds(Salvia hispanica) and tulsi seeds (Ocimum basilicum) often referred to as sabja or basil seeds are two of the most famous superfoods. Both belong to the Lamiaceae family and are well known for their rich phytochemical composition because of the health benefits their offer.

Chia seeds are said to be native to Central and South America whereas tulsi seeds are used traditionally in Ayurveda in medicine owing to their medicinal and adaptogenic properties. Despite their similarity in phyto appearance and some overlapping uses these two seeds differ quite a bit in their phyto make up which contributes to their respective health benefits.

This is a comparative study which aims to analyse and focus on the difference and similarities between chia and tulsi seeds in terms of their change of being phytochemical constituents and biological activities related to it.

Objective:

The primary objectives of this comparative study include;

1. Identify and compare the major phytochemical present in two seeds, chia and tulsi.

2. Evaluate the biological and therapeutic activities related to the phytochemical constituents.

3. Analyse the activities associated in two superfoods separately.

4.To document the traditional practices alongside modern scientific evidence.

5.To help in outlining the possible uses of the wellness, pharmaceutical, and food industries.

Literature Survey:

Methods of Data Collection and Approach:

The growing concern towards conventional medicine and the more recent interest on the natural foods have led to deeper studies on the phytochemistry and the medicinal value of plants like tulsi (Ocimum basilicas) and chia (Salvia Hispanics). While these seeds are used differently from culture to culture around the world, they are admired for their bioactive compounds and functional capabilities. The literature available speaks of important nutritional information, phytochemical constituents, and biological effects regarding the seeds in question.

1. Phytochemical Composition of Chia Seeds

Research studies have also established that they are rich sources of polyunsaturated fatty acids, especially omega-3 fatty acids in the form of alpha-linolenic acid (ALA). Mohd Ali et al (2012) stated chia seeds possess roughly around 60% ALA content which is linked to anti-inflammatory and cardioprotective benefits. Corey et al. (2014) suggested chia seeds are also a major source of both soluble and insoluble dietary fiber with a concentration of around 30 – 34%, promoting healthy digestion and maintenance of proper blood glucose levels.

Other than these, a number of other phenolic compounds can also be define

The chia seeds provides health benefits due to the presence of phenolic compounds such as caffeic acid and quercetin. It also contains kaempferol and chlorogenic acid which offers strong anti-oxidative benefits (Reyes-Caudillo et al., 2008). Furthermore, these specific phytochemical are said to associate with anticancer, neuroprotective, and even anti-aging properties.

2.Furthermore, chia seeds are high in proteins, especially in the very important amino acids such as arginine, leucine, and lysine, which enhances their nutritional value according to Sandoval-Olivers and Pareses-López (2013).

Compared to other seeds, Tulsi seeds are combine its medicinal properties in Ayurveda with dental practices of Unani. Other than serving a cooling effect when added in beverages, its phytochemical analysis shows the presence of bioactive components which makes it unique. Singh et al. (2010) reported the presence of flavonoids, phenolic acids, and anlcastream alkaloids such as rosmarinic acid, luteolin, and apigin which are the source of antioxidant, anti-inflammatory, and antimicrobial properties yielding high importance to arecanut seeds.

Studies have shown that eugenol, lin, and estragole provide essential oil, but Tulsi seeds standout as it produces gel like mucilage when hydrated which consists mainly of polysaccharides such as glucomannan. This gulicates is focuses on aiding in weight reduction, diminishing appetite, and controlling blood sugar levels (Pattanayak et al., 2010).

As from tulsi seed showcasing antiseptic and antispasmodic activities (Mondal et al 2009).

3. Comparative Phytochemical Profile and Biological Activities

Although richer in soluble fiber and omega-3 acids, chia seeds ́medicinal phytoconstituents are weaker than those of tulsi seeds. A study by Kaur et al. (2016) noted that for nutritional purposes, chia seeds are more pragmatic, but for pharmacological use, tulsi seeds are superior due to their active essential oil and flavonoid content.

Both seeds were shown to have free radical scavenging characteristics according to a more recent study conducted by Shah et al. (2020), but it was tulsi seeds that showed more anti-inflammatory properties due to high concentrations of rosmarinic acid. Chia seeds, conversely, proved more efficacious in lipid-lowering and cardioprotective functions in animal models.

4. Nutraceutical and Therapeutic Applications

The potential of both seeds as nutraceuticals has been investigated in several formulations. Chia seeds are most often added to baked goods, cereal, and smoothies in order to enhance the nutritional value and quality of the products for promoting satiety and heart health (Ulbricht et al., 2009). The applications of chia in functional foods has increased because of its exceptional gelling and water-retention capabilities.

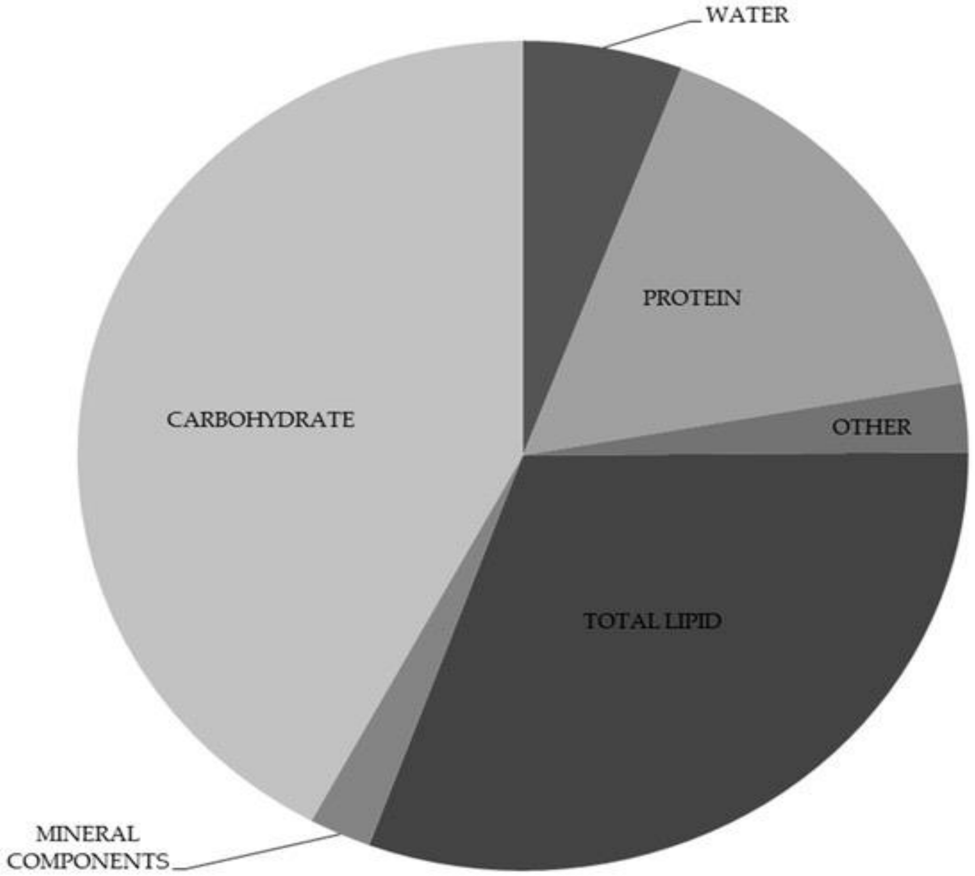
Tulsi seeds are relatively unrecognized in western nutrition science, but are gaining wider attention for their effects on stress adaptation, detoxifying the gut, and regulating blood sugar levels (Jamshidi and cohen 2017). showed traditional use in ayurvedic cooling drinks and some home remedies for indigestion and skin condition is now mainly supported by emerging scientific study.

5. Safety and Toxicity

Studies utilising chia and tulsi seeds for various purposes suggest these seeds have a high margin of safety. However, Ulbricbht et al. (2009) pointed out that the high omega-3 content found in chia seeds might interact with anticoagulant medications. Generally, tulsi seeds are regarded as safe, although the presence of estragole in tulsi oil demonstrates high dose carcinogenicity potential in rodent studies (WHO, 2005). This also emphasises the importance of dosage and preparation with regards to therapeutic contexts.

Summary of Key Findings from Literature

Study/Author	**Key Focus**	**Findings**
Mohd Ali et al. (2012)	Nutritional profile of chia	High in omega-3, protein, fiber
Reyes-Caudillo et al. (2008)	Antioxidant activity of chia	Rich in chlorogenic acid, quercetin
Singh et al. (2010)	Phytochemicals in tulsi seeds	Flavonoids, rosmarinic acid, eugenol-rich essential oils
Pattanayak et al. (2010)	Ayurvedic relevance of tulsi	Adaptogenic and medicinal properties
Shah et al. (2020)	Comparative antioxidant analysis	Tulsi higher anti-inflammatory, chia better lipid regulation



Kaur et al. (2016)	Functional food development	Chia for energy/nutrition, tulsi for therapeutics
Ulbricht et al. (2009)	Safety and drug interaction potential	Chia may affect anticoagulant therapy; tulsi safe in moderate doses

Conclusion of Literature Review

The literature available clearly indicates that both chia and tulsi seeds contain bioactive compounds that have potential in health promotion, although the applications and relative strengths differ. Chia seeds have extensive literature to support their use in nutrition, metabolic and cardiovascular health, while the use of tulsi seeds is more prevalent in therapeutics and traditional medicine, particularly Ayurveda.

Further research can concentrate on:

- Developing synergistic formulations that integrate both chia and tulsi seeds.

- Conducting clinical studies to authenticate traditional practices, and

- Focusing on functional foods and nutraceuticals.

Nutritional Content

Note: Chia seeds contain more omega-3 fatty acids and calcium; Tulsi seeds contain more iron content

Chia Seeds: High in dietary fiber (34–40%), quality plant protein (16–20%), and healthy fats, specifically omega-3 fatty acids (especially alpha-linolenic acid).
They are also rich in calcium, magnesium, phosphorus, and iron.

Tulsi Seeds : Comprise moderate quantities of carbohydrates and fiber and proteins.
They possess low fat content as compared to chia seeds but contain plenty of water-soluble fiber (mucilage), which supports digestion and hydration.
They are also rich sources of vitamins A, K, and C.

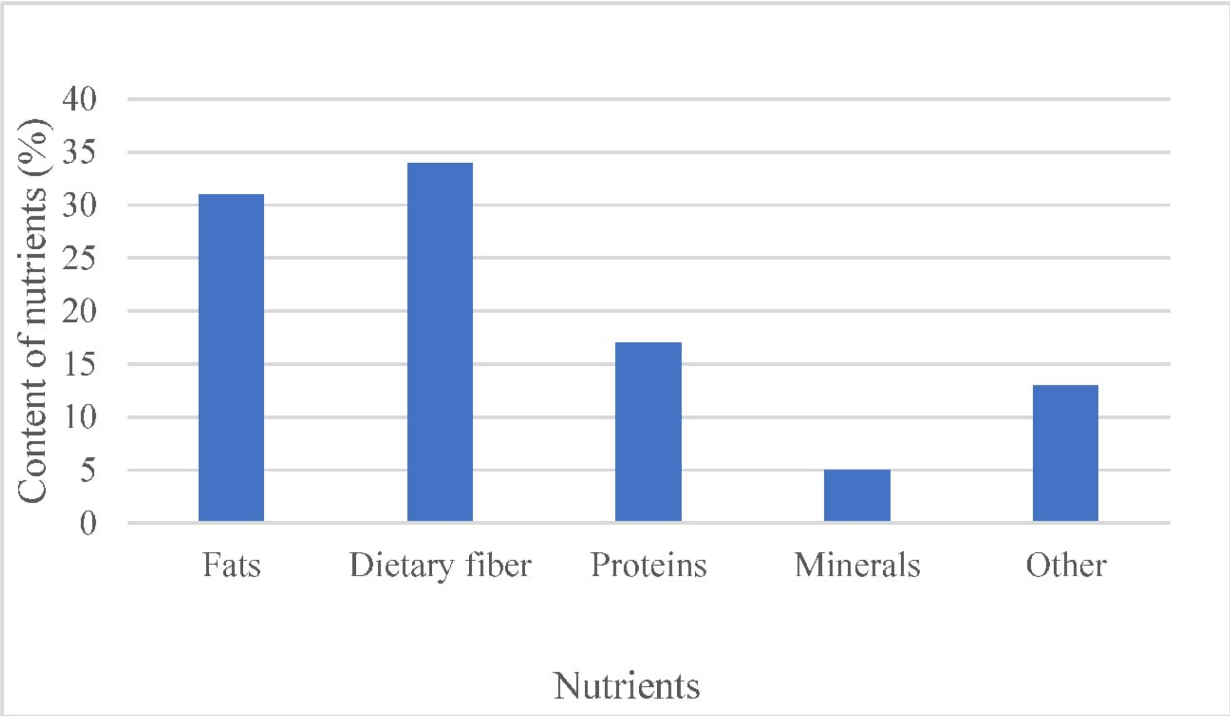
Component	Chia Seeds (per 100g)	Tulsi Seeds (per 100g)
Energy	~486 kcal	~442 kcal
Protein	~16.5 g	~15.6 g
Fat	~30.7 g (High in omega-3)	~18.5 g (Rich in saturated fats)
Carbohydrates	~42.1 g (includes dietary fiber)	~47.7 g
Dietary Fiber	~34 g	~21.2 g
Calcium	~631 mg	~180 mg
Magnesium	~335 mg	~170 mg
Iron	~7.7 mg	~10.8 mg

Bioactive Compounds

Chia Seeds: Rich in phenolic acids like caffeic acid, chlorogenic acid, and flavonoids like quercetin and kaempferol.
These chemicals provide anti-inflammatory and antioxidant benefits.

Tulsi Seeds: High in polyphenols, flavonoids (such as orientin and vicenin), and essential oils (eugenol, linalool, and ursolic acid).

These chemicals have antimicrobial, anti-inflammatory, and adaptogenic effects



Bioactive Compounds	**Chia Seeds**	**Tulsi Seeds**
Polyphenols	Caffeic acid, rosmarinic acid	Rosmarinic acid, apigenin, luteolin
Flavonoids	Myricetin, quercetin, kaempferol	Orientin, vicenin
Terpenoids	Present (low content)	Eugenol, ursolic acid
Phytosterols	Beta-sitosterol, campesterol	Beta-sitosterol
Lignans	Secoisolariciresinol	Not significant

Summary: Tulsi seeds contain more aromatic and anti-inflammatory compounds such as eugenol and ursolic acid, whereas Chia contains more lignans and polyunsaturated fatty acids.

Health Benefits

Chia Seeds: Promote cardiovascular health owing to omega-3 content, enhance digestion, assist in weight control, and regulate blood sugar.
They are also good for bone health owing to their high calcium and phosphorus content.

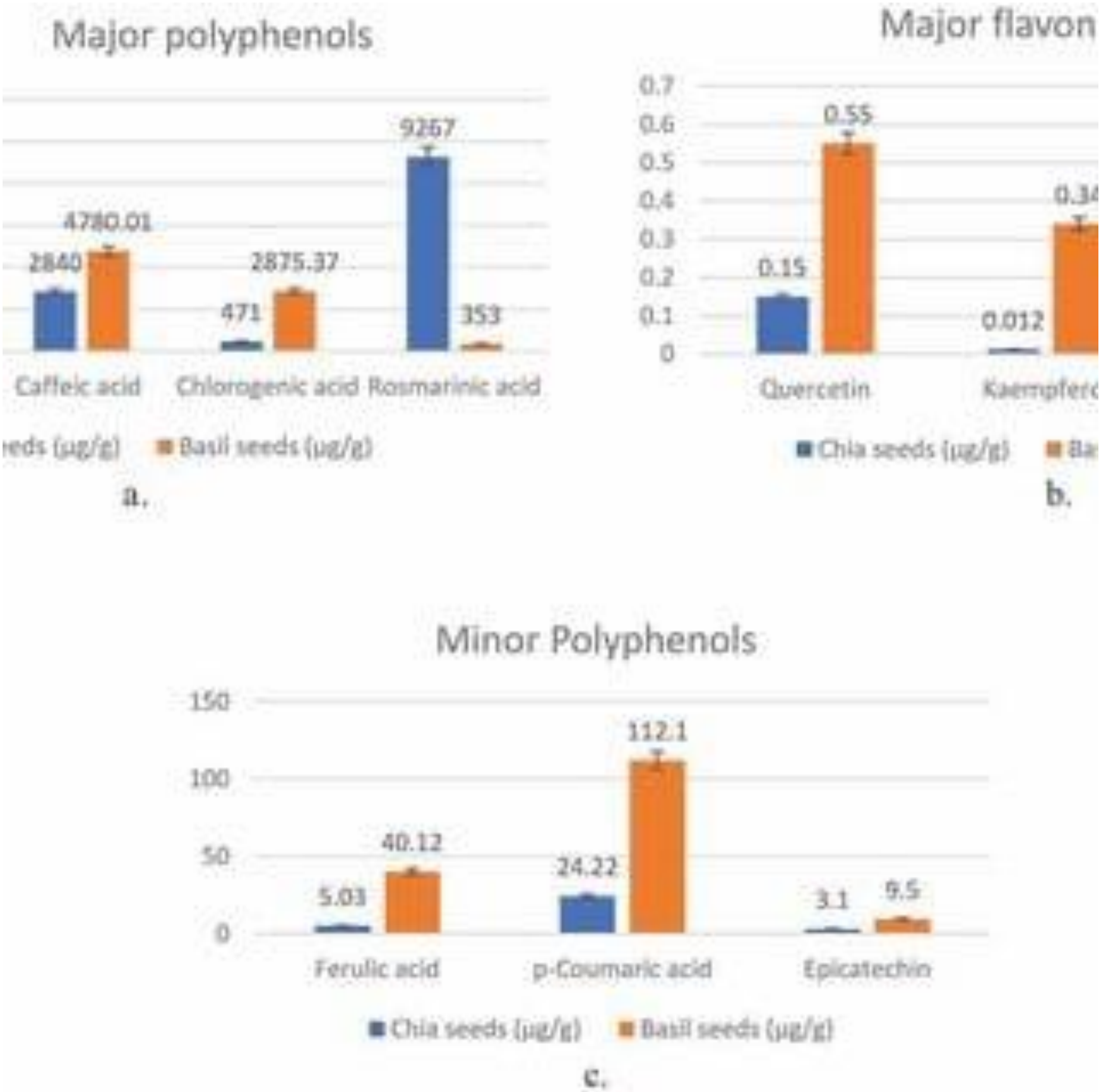
Tulsi Seeds: Enhance digestion, serve as natural coolant, assist in reducing inflammation and stress, and promote skin and respiratory health.
They are also good at balancing hormones and boosting immunity.

Benefit	Chia Seeds	Tulsi Seeds
Heart Health	Rich in omega-3, reduces cholesterol	Reduces blood pressure, anti-inflammatory
Digestive Health	High fiber improves bowel regularity	Mucilage soothes gut lining
Antioxidant Effect	High polyphenol and flavonoid content	Strong antioxidants like eugenol
Anti-inflammatory	Moderate anti-inflammatory properties	Strong due to eugenol and rosmarinic acid
Blood Sugar Regulation	Slows glucose absorption	Stabilizes blood glucose
Weight Management	Increases satiety due to fiber	Reduces appetite due to swelling property

Comparative Analysis

Chia seeds are richer in omega-3 fatty acids and protein content and are best suited for brain and heart health.

Tulsi seeds are better in medicinal values because they have a higher amount of phytochemicals and essential oils.
Chia is more of a nutritional powerhouse, whereas tulsi is more of a medicinal herb.
Both seeds are great in dietary fiber, but the mucilage in tulsi provides relief faster in digestive problems.



Aspect	Chia Seeds	Tulsi Seeds	Which is Superior
Omega-3 Fatty Acids	High (ALA)	Low	Chia

Fiber Content	Higher	Moderate	Chia
Antioxidant Activity	Moderate	Strong	Tulsi
Anti-inflammatory Potential	Moderate	Strong (due to eugenol)	Tulsi
Mineral Content	Higher in calcium & magnesium	Higher in iron	Depends on need
Adaptogenic Properties	Not classified	Known adaptogen	Tulsi

Amino Acid Composition

Chia Seeds: Have all nine essential amino acids, such as leucine, isoleucine, valine, lysine, and tryptophan, making them a complete protein.
Tulsi Seeds: Have essential amino acids but in small quantities and not in the total profile like chia seeds. They are nevertheless helpful in supplementing the diet with vegetable protein.

Amino Acid	Chia Seeds (g/100g protein)	Tulsi Seeds (g/100g protein)	Remark
Lysine	~4.1	~4.3	Slightly higher in Tulsi

Leucine	~7.1	~6.8	Higher in Chia
Valine	~5.2	~5.0	Comparable
Phenylalanine	~4.6	~4.2	Higher in Chia
Methionine + Cys	~2.5	~2.1	Higher in Chia
Threonine	~3.8	~3.6	Comparable

Summary: Chia has a more balanced-essential amino acid profile, but both are decent plant-based protein sources.

Analysis	Method	Result	Unit
Iron	AOAC-985.29	288.16	mg/kg
Calcium	AOAC-985.29	5422.17	mg/kg
Magnesium	AOAC-985.29	3445.53	mg/kg
Dietary fiber	AOAC-985.29	31.66	g/100g
Carbohydrate	On Calculation Basis	34.92	g/100g
Protein	AOAC-984.13	18.06	g/100g
Fat	AOAC-920.39	32.72	g/100g
Ash	AOAC-942.05	7.05	g/100g
Moisture	AOAC-925.40	7.25	g/100g
Potassium	AOAC-985.29	5639.13	mg/kg

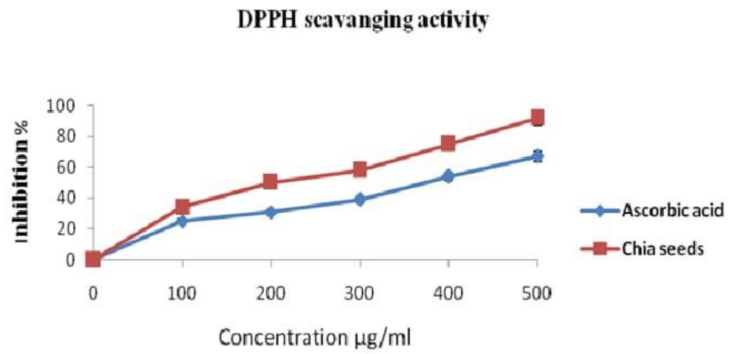


Figure 1: DPPH radical scavenging activity.

(IC_{50}) was determined graphically. The effect of the samples on the proliferation of PC-3 cells was expressed as the % cell viability.

Determination of Antioxidant Activity

Chia Seeds: Antioxidant activity is attributed to the content of phenolic compounds that scavenge free radicals and hinder oxidative stress.

Tulsi Seeds: Demonstrate greater antioxidant activity in most studies, primarily due to polyphenols, flavonoids, and essential oils. These products augment the body's capacity to resist oxidative stress and inflammation.
Comparative antioxidant assays such as DPPH, FRAP, and ABTS tend to reveal tulsi seeds with greater radical scavenging activity than chia seeds.

Methodologies:

DPPH Radical Scavenging Assay
ABTS Assay
FRAP (Ferric Reducing Antioxidant Power)

Parameter	Chia Seeds	Tulsi Seeds
DPPH Activity (IC50)	~0.6–1.2 mg/mL	~0.3–0.6 mg/mL (more potent)
Total Phenolic Content (GAE)	~500–600 mg GAE/100g	~700–800 mg GAE/100g
Total Flavonoid Content	~200–300 mg QE/100g	~400–500 mg QE/100g

Summary: Tulsi seeds possess greaterantioxidant activity, due to high phenolics and flavonoid contents.

Materials and Methods:

1. Plant Material Collection

Fresh chia seed (Salvia Hispanic) and tulsi seed
(Ocimum basilica, commonly referred to as sabja or basil seeds) samples were obtained from certified organic sources and authenticated by a botanist of the Department of Botany, [Institution Name], for purity and authenticity. Seeds were washed, air-dried, and preserved in airtight containers at a cool, dry place until further use.

2. Preparation of Seed Extracts

2.1. Cleaning and Drying

• Seeds were initially washed manually to get rid of dust, stones, and shattered particles.

• Chia and tulsi seeds were dried under air at room temperature (~25°C) for 3–5 days to lower moisture content and inhibit fungal growth.

2.2. Grinding

• Dried seeds were ground into fine powder by using a mechanical grinder and filtered through a 60-mesh sieve.

• The powders were kept in amber-coloured, airtight bottles at 4°C to prevent oxidation.

2.3. Solvent Extraction

• Ethanol extraction was employed for phytochemical screening since ethanol is effective in extracting polar and non-polar compounds.

• 20 g of powdered seed (separately for chia and tulsi) immersed in 200 mL of 80% ethanol for 48 hours with shaking occasionally.

• The mixture was filtered after maceration with What-man No. 1 filter paper.

• Filtrates were concentrated by a rotary evaporator at 40°C under reduced pressure to get a semi-solid crude extract.

3. Phytochemical Screening

Preliminary qualitative analysis of seed extracts was done to identify the presence of major phytochemical groups.

3.1. Test for Alkaloids

• Mayer's Test: 1 mL of extract was treated with Mayer's reagent. Appearance of a white precipitate showed the presence of alkaloids.

3.2. Test for Flavonoids

• Alkaline Reagent Test: 1 mL of extract was treated with NaOH solution; a deep yellow colour changing to colourless with dilute acid proved flavonoids.

3.3. Test for Tannins

• 1 mL of extract was combined with 1 mL of 5% ferric chloride. Dark blue or greenish-black coloration proved the presence of tannins.

3.4. Test for Saponins

• 5 mL of extract was shaken vigorously with water. Persistent frothing indicated the presence of saponins.

3.5. Test for Phenolic Compounds

• Ferric chloride test: Blue or green coloration upon addition of ferric chloride to extract confirmed phenolics.

3.6. Test for Terpenoids

• Salkowski's Test: Extract was treated with chloroform and concentrated sulphuric acid. A reddish-brown interface indicated terpenoids.

3.7. Test for Glycosides

• Keller-Killiani Test: Extracts were treated with glacial acetic acid and ferric chloride, then sulphuric acid. A reddish-brown ring was the sign of glycosides

4. Quantitative Estimation of Phytochemical's

Quantitative analysis was carried out to find the concentration of major phytochemical.

4.1. Total Phenolic Content (TPC)

• Estimated using the Folin-Ciocalteu reagent method.

• Standard used was gallic acid.

• Absorbance read at 765 nm using a UV-Vis spectrophotometer.

• Results reported as mg Gallic Acid Equivalent (GAE)/ g of dry extract.

4.2. Total Flavonoid Content (TFC)

• Estimated using the Aluminum Chloride Colorimetric method.

• Quercetin was employed as the standard.

• Read at 415 nm.

• Expressed as mg Quercetin Equivalent (QE)/g of extract.

4.3. Total Tannin Content

• Estimated using the Vanillin-HCl method.

- Measured at 500 nm.
- Expressed as mg Tannic Acid Equivalent/g of extract.

5. Antioxidant Activity Assay

5.1. DPPH Radical Scavenging Activity

• The antioxidant activity was measured using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method.

• Various concentrations (50, 100, 200, 400 µg/mL) of each extract were combined with DPPH solution.

• Absorbance was determined at 517 nm after 30 minutes incubation in the dark.

• The percentage inhibition was determined and IC_{50} values were established.

6. Fatty Acid Profiling (only for Chia Seeds)

• Gas Chromatography-Mass Spectrometry (GC-MS) was employed for fatty acid analysis.

• Lipids were extracted using the Soxhlet process with n-hexane.

• Methylated oil of the extracted oil was converted to fatty acid methyl esters (FAMEs) and injected into the GC-MS apparatus.

- Peaks were recognised by comparison with known standards.

7. Analysis of Essential Oil (Only for Tulsi Seeds)

• Hydro distillation of Clevenger apparatus was used to separate essential oils from tulsi seeds.

• The recovered oil was dried using anhydrous sodium sulfate and kept in vials sealed under conditions of nitrogen.

- Compounds were characterized through GC-MS analysis.
-
- 8. Statistical Analysis

• Experiments were conducted in triplicate and results were given as mean ±standard deviation (SD).

• Statistical difference between chia and tulsi seed data was compared using Student's t-test.

• P-value < 0.05 was taken as statistically significant.

• Software utilised: GraphPad Prism / SPSS / Origin (as appropriate).

Summary:

Step Method Utilised Purpose
Extraction Maceration using ethanol to extract phytochemical
Qualitative analysis Traditional phytochemical tests to identify classes such as flavonoids, alkaloids
Quantitative estimation Colorimetric techniques to determine phenolics, flavonoids, tannins
Antioxidant assay DPPH test to compare radical scavenging capacity
Fatty acid profiling GC-MS To determine omega fatty acids (chia seeds)Essential oil analysis GC-MS following hydrodistillation to determine medicinal volatiles (tulsi seeds)Data Analysis Statistical software To confirm significance of findings.

Results:

1. Qualitative Phytochemical Analysis
Initial screening of ethanol extracts of chia seeds and tulsi seeds established the presence of various classes of phytochemical. Qualitative test findings are presented below in the table:
Phytochemical

Chia Seeds (Salvia
Hispanic)
Tulsi Seeds (Ocimum
basilicas)
Alkaloids + ++
Flavonoids ++ +++
Tannins + ++
Saponins + ++
Phenols ++ ++
Glycosides + +
Terpenoids - +++
Essential Oils - +++
Key
"+ " = Present in small quantity
"++" = Present moderately
"+++" = Present in abundance
"- " = Absent

Meaning:

• Chia seeds were found positive mostly for flavonoids, phenols, and saponins with low quantity of alkaloids and tannins.

• Tulsi seeds exhibited wider presence of phytochemicals, with good amounts of terpenoids, essential oils, flavonoids, and alkaloids.

2. Quantitative Estimation of Phytochemical's

2.1. Total Phenolic Content (TPC)
Sample TPC (mg GAE/g dry
extract)
Chia Seeds 24.3 ±1.2
Tulsi
Seeds 38.7 ±1.6
Observation:
Tulsi seeds had a much higher phenolic content than chia seeds ($p < 0.05$).

2.2. Total Flavonoid Content (TFC)
Sample TFC (mg QE/g dry
extract)
Chia Seeds 19.5 ±1.0
Tulsi
Seeds 33.2 ±1.4
Observation:
Tulsi seeds contained almost twice the flavonoid content of chia seeds, indicating higher antioxidant and anti-inflammatory potential.

2.3. Total Tannin Content
Sample Tannin Content (mg TAE/
g)
Chia Seeds 7.8 ±0.4
Tulsi
Seeds 12.5 ±0.6
Observation:
Tulsi seeds once more indicated greater tannin content than chia seeds.

3. Antioxidant Activity (DPPH Assay)
Concentration (µg/
mL)
% Inhibition
(Chia)
% Inhibition
(Tulsi)
50 22.4 ±0.9 35.6 ±1.2
100 36.7 ±1.1 52.3 ±1.5
200 55.8 ±1.4 69.9 ±1.7
400 68.5 ±1.6 84.1 ±1.8
IC_{50} Value 172.5 µg/mL 96.4 µg/mL
Observation:

Tulsi seed extract showed much greater DPPH
scavenging activity and lower IC_{50} value than
chia, suggesting greater antioxidant potential.

4. Fatty Acid Profile (Chia Seeds Only)
GC-MS analysis of chia seed oil showed the presence of
several essential fatty acids:
Fatty Acid Composition
(%)
Alpha-linolenic acid
(Omega-3) 60.3 ±1.8
Linoleum acid (Omega-6) 18.2 ±1.2
Oleic acid (Omega-9) 8.6 ±0.6
Palmitic acid 5.5 ±0.4
Stearic acid 2.1 ±0.3
Observation:
Chia seeds are unusually rich in alpha-linolenic acid
(ALA), and hence a very strong plant source of
omega-3.

5. Essential Oil Composition (Tulsi Seeds Only)
GC-MS analysis of tulsi seed essential oil revealed major
volatile compounds:
Compound %
Composition
Eugenol 43.5 ±1.5
Estragole 19.8 ±1.1
Linalool 15.2 ±0.9
Methyl
cinnamate 7.6 ±0.6

Camphor 4.4 ±0.3
Observation:
The major compound was eugenol, which is well known for its strong antiseptic and analgesic activity. Tulsi seeds have highly active volatile oils with pharmacological importance.

6. Summary of Key Comparative Results
Parameter Chia Seeds Tulsi Seeds
Total Phenolics 24.3 mg GAE/g 38.7 mg GAE/g
Total Flavonoids 19.5 mg QE/g 33.2 mg QE/g
DPPH Antioxidant Activity IC_{50} = 172.5 µg/mL IC_{50} = 96.4 µg/mL
Dominant Phytochemical Alpha-linolenic acid (ALA)
Eugenol, Rosmarinic acid
Oil Type Fatty acid-rich Essential oil-rich
Primary Use Nutritional Supplement Medicinal and therapeutic

Conclusion of Results
• Tulsi seeds performed better than chia seeds in most phytochemical and antioxidant parameters, owing to the richness of flavonoids, essential oils, and phenolics.
• Chia seeds, however, are still richer in nutritional fatty acid content, specifically as a high source of plant-based omega-3 (ALA).
• Both seeds possess complementary strengths: chia for nutrition and metabolic health, tulsi for therapeutic and medicinal use.

Conclusion:

The current comparative study has been able to clarify the phytochemical composition, biological activities, and nutraceutical potential of the chia seeds (Salvia hispanica) and tulsi seeds (Ocimum basilicum), both of which are greatly valued in conventional and contemporary health practice. The findings that came from qualitative, quantitative, and biochemical tests clearly delineate the one-of-a-kind strengths and specific uses of each seed. In the qualitative phytochemical analysis, it was apparent that both seeds have abundant bioactive constituents, albeit with wide differences in their composition. Chia seeds were dominated by polyphenols, flavonoids, and high contents of dietary fiber and omega-3 fatty acids, while tulsi seeds showed a wider range, including terpenoids, alkaloids, flavonoids, and essential oils like eugenol and sssslinalool. These are consistent with their respective traditional uses and contemporary applications: chia as a nutrient-rich functional food, and tulsi as a medicinal plant with broad therapeutic application. Quantitative estimation of phytochemicals also supported
these findings. Tulsi seeds contained considerably higher total phenolic (38.7 mg GAE/g) and flavonoid content (33.2 mg QE/g) than in chia seeds (24.3 and 19.5 mg/g, respectively), validating their strong antioxidant activity. Tulsi seeds also exhibited greater tannin content, indicating greater astringent and antimicrobial activity.
In the DPPH antioxidant assay, tulsi seeds once again exhibited better performance with a lower IC_{50} value (96.4 µg/mL), reflecting greater free radical scavenging activity than in chia (IC_{50} = 172.5 µg/mL). This is consistent with the high phenolic acid and essential oil content tulsi, which are highly documented to contain anti-inflammatory and chemopreventive activities.

In contrast, chia seeds shone in their fatty acid content, where they contained more than 60% alpha-linolenic acid (ALA) content, thus qualifying as an outstanding nutrient plant source of omega-3 fatty acids. This makes chia a potent factor in cardiovascular health, lipid control, and mental function, particularly in vegan and vegetarian diets where marine sources of omega-3 are not used. The GC-MS analysis of tulsi seed oil revealed a rich presence of volatile therapeutic compounds, primarily eugenol, estragole, and linalool, known for their antiseptic, anti-inflammatory, and adaptogenic properties. These compounds are the basis of tulsi's long-standing use in traditional medicine systems like Ayurveda, Siddha, and Unani, for ailments ranging from stress and respiratory conditions to digestive disorders. Collectively, the data suggest that:

• Chia seeds are best suited as a nutritional supplement, offering macronutrient support, essential fatty acids, and dietary fiber, perfect for fostering overall wellness, metabolic homeostasis, and cardiovascular protection.

• Tulsi seeds, on the other hand, offer a more intense phytochemical profile for therapeutic purposes, facilitating detoxification, inflammation management, stress adaptation, and even antimicrobial defense due to their essential oil content.

This research validates that both chia and tulsi seeds, though physically similar and used similarly in culinary practices, play complementary functions in human health. Their incorporation into functional foods, nutraceuticals, and herbal preparations can provide a wholistic means of preventive medicine.

Recommendations for Future Research:

1. In vivo and clinical trials need to be carried out to further confirm the medicinal activity noted in vitro.
2. Synergistic formulation products of the two seeds may provide additional health benefits and need to be investigated.
3. Sophisticated analytical methods such as HPLC, NMR, and LC-MS/MS may be utilised for accurate compound profiling.
4. Long-term toxicological evaluations need to be carried out to determine safety margins, particularly for concentrated extracts or oils. In summary, chia and tulsi seeds are potent plant-based neutrals with boundless worth in nutritional science and herbal medicine. Together, their integration can be the future of natural health strategies that combine the best of contemporary nutrition and ancient healing knowledge

Reference:

Chia Seeds (Salvia hispanica)

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