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Original Research Article

# Formulation and Evaluation of Chia Based Health Drink

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**Abstract:** The present study focuses on the formulation and evaluation of a chia-based health drink utilizing Salvia hispanica L. as a functional ingredient. Chia seeds are widely recognized for their high nutritional value, including omega-3 fatty acids, dietary fiber, proteins, minerals, and bioactive phytochemicals with significant health-promoting properties. The objective of this research was to develop a palatable, stable, and nutritionally enriched beverage by incorporating varying concentrations of chia seeds along with suitable sweeteners, flavoring agents, and stabilizers.

The health drink formulations (F1–F5) were prepared by dispersing pre-soaked chia seeds in a liquid medium under controlled conditions. The prepared formulations were evaluated for organoleptic properties, pH, viscosity, and sedimentation behavior to determine their quality and acceptability. The results indicated that an increase in chia seed concentration improved viscosity, texture, and physical stability due to the formation of a mucilaginous gel network. All formulations exhibited near-neutral pH, indicating compatibility and suitability for oral consumption.

Among the developed formulations, F4 demonstrated optimal performance in terms of sensory attributes, viscosity, and stability, making it the most acceptable formulation. The study concludes that chia seeds can be effectively utilized in the development of functional beverages with enhanced nutritional and physicochemical properties. This formulation approach holds significant potential for application in the nutraceutical and functional food industry.

**Keywords:** Chia seeds; Salvia hispanica L.; Functional food; Nutraceuticals; Health drink; Formulation; Evaluation; Viscosity; Stability; Organoleptic properties.

## 1. Introduction

### 1.1. Background of the Study

#### 1.1.1. Overview of Functional Foods and Nutraceuticals

In recent years, the concept of food has expanded beyond basic nutrition to include its role in promoting health and preventing disease. Functional foods are those that offer additional health benefits due to bioactive compounds such as polyphenols, flavonoids, dietary fiber, and omega fatty acids.

Nutraceuticals, a combination of "nutrition" and "pharmaceutical," refer to food-derived substances that provide both nutritional and therapeutic benefits. These include dietary supplements, herbal products, and specialized diets that help reduce the risk of chronic conditions like diabetes, cardiovascular diseases, cancer, and neurodegenerative disorders. They are generally considered safer and are commonly consumed as part of a regular diet.

#### 1.1.2 Growing Trend of Plant-Based Nutraceuticals

The nutraceutical market has grown rapidly due to increasing awareness of preventive healthcare and concerns over synthetic drugs. Plant-based nutraceuticals are particularly popular because they are rich in phytochemicals such as alkaloids, terpenoids, phenolic acids, and flavonoids, which exhibit antioxidant, anti-inflammatory, and antimicrobial effects.

With the demand for natural and sustainable products rising, plant sources like seeds, fruits, herbs, and grains are gaining research interest. Among them, chia seeds (*Salvia hispanica* L.) stand out for their high levels of omega-3 fatty acids, dietary fiber, protein, and essential minerals, making them highly suitable for functional foods and health supplements.

### 1.1. About Chia Seeds (*Salvia hispanica L.)*

#### 1.1.1 Botanical Source, Family, and Distribution

Chia seeds are derived from *Salvia hispanica* L., a member of the Lamiaceae (mint) family. It is an annual herb native to Central and South America, especially Mexico and Guatemala, where it has been cultivated for centuries. The plant grows up to 1–1.5 m in height, with opposite leaves, small blue or purple flowers, and tiny oval seeds (~2 mm) that range in color from black to white or gray with a glossy surface.

Today, chia is cultivated globally, including in Australia, Argentina, Bolivia, Peru, and India, driven by rising demand. It grows well in warm tropical and subtropical climates and prefers well-drained soil, making it a versatile crop for both agricultural and nutraceutical applications.

***Figure 1: Chia Seeds***

### 1.2 Importance of the Study

Chia seeds are derived from *Salvia hispanica* L., a member of the Lamiaceae (mint) family. It is an annual herb native to Central and South America, especially Mexico and Guatemala, where it has been cultivated for centuries. The plant grows up to 1–1.5 m in height, with opposite leaves, small blue or purple flowers, and tiny oval seeds (~2 mm) that range in color from black to white or gray with a glossy surface.

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by rising demand. It grows well in warm tropical and subtropical climates and prefers well-drained soil, making it a versatile crop for both agricultural and nutraceutical applications.

#### 1.3.2 Role in Modern Diet and Therapeutic Use

Chia has gained renewed attention due to extensive research highlighting its nutritional and pharmacological benefits. It is a rich source of $\alpha$-linolenic acid (ALA), omega-3 fatty acids, dietary fiber, protein, antioxidants, and essential minerals like calcium, magnesium, and phosphorus.

Additionally, chia's ability to absorb water and form a gel-like texture makes it suitable for various food applications, including low-calorie and gluten-free diets. Owing to these benefits, research on its pharmacological properties and extraction methods is highly valuable for nutraceutical and pharmaceutical advancements

## 2: Botanical and Phytochemical Profile

### 2.1 Botanical Description Scientific Classification

*Salvia hispanica L.*, commonly known as chia, belongs to the family *Lamiaceae* (mint family). It is a flowering herbaceous plant cultivated primarily for its seeds, which are renowned for their exceptional nutritional and medicinal properties. The scientific classification of chia is given below.

**Table 1: The scientific classification of chia**

| Taxonomic Rank | Classification |
|---|---|
| Kingdom | Plantae |
| Division | Magnoliophyta |
| Class | Magnoliopsida |
| Order | Lamiales |
| Family | Lamiaceae |
| Genus | *Salvia* |
| Species | *Salvia hispanica* L. |
| Common Name | Chia |
| Origin | Central and Southern Mexico, Guatemala |

The plant is an annual herb that grows up to 1–1.2 meters tall, bearing opposite leaves and small white or purple flowers arranged in terminal racemes.

**Morphological Features of Plant and Seeds**

The chia plant is upright and branched, with quadrangular stems typical of the mint family. The leaves are opposite, serrated, and ovate, measuring about 4–8 cm long and 3–5 cm wide. The flowers are small, bilabiate, and form dense spikes at the terminal ends of branches.

The chia seeds are small, oval, and about 2 mm in length. They have a smooth and shiny surface with mottled colors varying from black, white, brown to gray. When soaked in water, the seeds form a gel- like mucilaginous coat, a result of soluble fiber (mainly mucilage polysaccharides) present in the seed coat. This property plays a key role in their hydrophilic nature, making them valuable for food and nutraceutical applications.

### **2.3** Chemical Composition

Chia seeds are considered a nutrient-dense functional food, rich in macronutrients, micronutrients, and bioactive phytochemicals. Their balanced nutritional profile contributes to both nutraceutical and pharmacological value.

#### **2.3.1** Macronutrient Composition

Chia seeds are an excellent source of proteins, carbohydrates, and lipids.

**Proteins (15–25%)**: High in essential amino acids such as leucine, lysine, and valine.

**Carbohydrates (30–40%)**: Primarily in the form of dietary fibers (both soluble and insoluble).

**Lipids (30–33%)**: Rich in polyunsaturated fatty acids, particularly omega-3 $\alpha$-linolenic acid (ALA) and omega-6 linoleic acid (LA).

The ratio of omega-6 to omega-3 (≈0.3:1) makes chia unique among plant seeds.

**2.3.2** Micronutrient Composition

Chia seeds are rich in minerals and vitamins, which contribute to their health-promoting potential. They are an excellent source of calcium, magnesium, potassium, phosphorus, and zinc, with moderate amounts of iron and copper.

These micronutrients contribute to bone health, metabolic regulation, and antioxidant defense.

**2.3.3** Phytochemical Composition

Chia seeds contain a wide range of bioactive compounds, which contribute to their pharmacological activities such as antioxidant, anti-inflammatory, antidiabetic, and cardioprotective effects. The major phytochemicals include:

**Phenolic compounds**: Caffeic acid, chlorogenic acid, quercetin, kaempferol, and rosmarinic acid.

**Flavonoids**: Myricetin, apigenin, and luteolin, known for strong antioxidant properties.

**Omega-3 fatty acids**: Predominantly alpha-linolenic acid (ALA), beneficial for cardiovascular and brain health.

**Fibers**: Both soluble and insoluble, aiding in gut health and reducing cholesterol levels.

**Mucilage polysaccharides**: Responsible for water retention and gel formation, useful in digestion and sustained energy release

## 2. Materials and Methods

### Materials

All materials used in the formulation and evaluation of the chia-based health drink were of analytical and food-grade quality. The selection of materials was based on their nutritional value, safety, and suitability for functional beverage preparation. The materials were categorized into raw materials and chemicals/reagents.

### Raw Materials

The primary raw material used in the formulation was chia seeds (*Salvia hispanica L.*), which were procured from a certified local supplier and authenticated based on standard botanical characteristics. The base medium for the preparation of the health drink consisted of milk or water, depending on the formulation requirements. Natural sweeteners such as honey, sugar, or jaggery were incorporated to enhance palatability and consumer acceptability. Flavoring agents, including vanilla, cocoa, and fruit extracts, were added to improve sensory characteristics.

To enhance the consistency and stability of the formulation, stabilizers such as xanthan gum or guar gum were optionally used. In certain formulations, preservatives like sodium benzoate or potassium sorbate were included to extend shelf life and prevent microbial growth.

**Table 2: Raw Materials Used in Formulation**

| Sr. No. | Material | Role in Formulation |
|---|---|---|
| 1 | Chia seeds (*Salvia hispanica L.*) | Functional ingredient (fiber, omega-3 source) |
| 2 | Water | Base medium |
| 3 | Honey | Sweetening agent |
| 4 | Vanilla | Flavoring agents |
| 5 | Xanthan gum | Stabilizers (improve viscosity and texture) |
| 6 | Sodium benzoate | Preservatives (optional) |

**Chemicals and Reagents**

Various analytical-grade chemicals and reagents were used for phytochemical and antioxidant evaluation of the formulation. Organic solvents such as methanol or ethanol were utilized for extraction of bioactive compounds when required. Distilled water was used throughout the experimental procedures to ensure purity and consistency.

**Table 3: Chemicals and Reagents**

| Sr. No. | Chemical/Reagent | Purpose |
|---|---|---|
| 1 | Methanol | Extraction of bioactive compounds |
| 2 | Distilled water | Solvent for preparation |
| 3 | Folin–Ciocalteu reagent | Determination of total phenolic content |
| 4 | DPPH reagent | Antioxidant activity evaluation |
| 5 | Gallic acid | Standard for phenolic content |
| 6 | Quercetin | Standard for flavonoid estimation |

**Preparation of Chia Seeds**

The chia seeds (*Salvia hispanica L.*) were subjected to preliminary processing prior to formulation. Initially, the seeds were carefully cleaned to remove dust, foreign particles, and other impurities. The cleaned seeds were then washed thoroughly with distilled water to ensure the removal of any adhering contaminants.

Subsequently, the seeds were soaked in distilled water in a ratio of 1:10 (w/v) for a period of 20–30 minutes. This soaking process facilitated the hydration of the seeds and promoted the formation of a gel-like mucilaginous layer due to the presence of soluble dietary fibers. The hydrated seeds exhibiting uniform gel formation were then utilized for the preparation of the health drink formulations.

**Preparation of Chia-Based Health Drink**

The chia-based health drink formulations were prepared by varying the concentration of chia seeds and other excipients as per the formulation design (F1–F5/F7). The objective was to optimize the formulation in terms of consistency, palatability, and nutritional value.

In the general preparation method, the selected base medium (milk or water) was measured accurately and transferred into a clean beaker. The pre-soaked and hydrated chia seeds were gradually added to the base liquid under continuous stirring to ensure uniform dispersion. Natural sweeteners such as honey, sugar, or jaggery were then incorporated to enhance taste, followed by the addition of suitable flavoring agents such as vanilla, cocoa, or fruit extracts to improve sensory attributes.

Where necessary, stabilizers such as xanthan gum or guar gum were added to enhance viscosity and prevent phase separation. The mixture was continuously stirred using a magnetic stirrer to achieve a homogeneous dispersion. The final formulation was then subjected to mild homogenization to ensure uniform consistency. The prepared chia-based health drink was transferred into suitable containers and stored under refrigerated conditions (4–8°C) until further evaluation.

**Formulation Design**

**Table 4: Composition of Chia-Based Health Drink Formulations**

| Formulation | Chia Seeds (%) | Sweetener (%) | Flavor | Stabilizer (%) |
|---|---|---|---|---|
| F1 | 1 | 5 | Vanilla | 0 |
| F2 | 2 | 5 | Cocoa | 0.1 |
| F3 | 3 | 6 | Strawberry | 0.1 |
| F4 | 4 | 6 | Mango | 0.2 |
| F5 | 5 | 7 | Chocolate | 0.2 |

## 4. Results and Discussions

### Organoleptic Evaluation

The organoleptic evaluation of all formulations (F1–F5) revealed significant differences in sensory attributes depending on chia seed concentration and excipient composition. Formulations with lower chia content (F1 and F2) exhibited good clarity and acceptable taste but lacked the characteristic thickness associated with chia mucilage. As the concentration of chia increased, improvements in texture and mouthfeel were observed due to enhanced gel formation.

Among all formulations, F4 and F5 showed superior organoleptic properties, particularly in terms of texture and overall acceptability. However, F5 exhibited slightly higher thickness, which may affect drinkability. Flavoring agents such as cocoa and fruit extracts significantly improved taste masking and consumer preference. Overall, F4 was identified as the most balanced formulation with optimal sensory characteristics.

**Table 5: Organoleptic Evaluation of Chia-Based Health Drink pH**

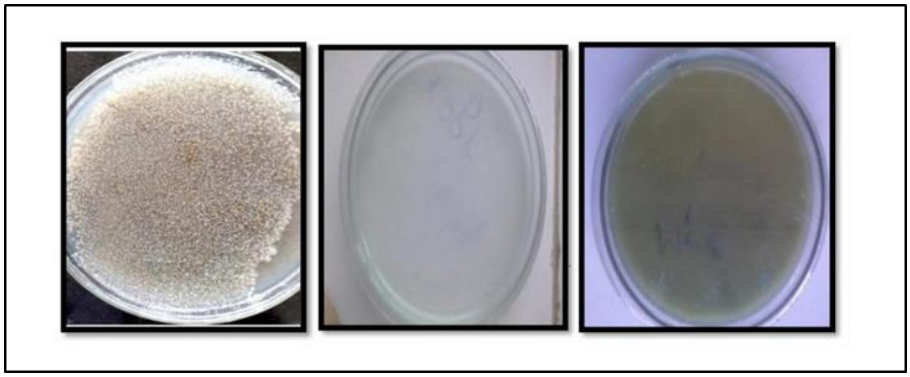
| Formulation | Color | Taste | Odor | Texture | Overall Acceptability |
|---|---|---|---|---|---|
| F1 | 7.0 ± 0.2 | 6.5 ± 0.3 | 6.8 ± 0.2 | 6.0 ± 0.3 | 6.4 ± 0.2 |
| F2 | 7.2 ± 0.3 | 6.8 ± 0.2 | 7.0 ± 0.3 | 6.5 ± 0.2 | 6.8 ± 0.3 |
| F3 | 7.5 ± 0.2 | 7.2 ± 0.3 | 7.3 ± 0.2 | 7.0 ± 0.3 | 7.3 ± 0.2 |
| F4 | 8.0 ± 0.2 | 7.8 ± 0.2 | 7.6 ± 0.3 | 7.8 ± 0.2 | 7.9 ± 0.2 |
| F5 | 8.2 ± 0.3 | 7.5 ± 0.2 | 7.7 ± 0.2 | 8.2 ± 0.3 | 7.8 ± 0.3 |

**Determination**

The pH values of all formulations were found to be within an acceptable range (approximately 6.2– 7.0), indicating near-neutral characteristics suitable for oral consumption. No significant variation in pH was observed with increasing chia concentration, suggesting that chia seeds do not significantly alter the acidity of the formulation. The stable pH values indicate good compatibility between ingredients and suggest minimal risk of irritation upon consumption.

**Table 6: pH of Chia-Based Health Drink**

| Formulation | pH (Mean ± SD) |
|---|---|
| F1 | 6.2 ± 0.05 |
| F2 | 6.3 ± 0.04 |
| F3 | 6.5 ± 0.03 |
| F4 | 6.7 ± 0.04 |
| F5 | 6.9 ± 0.05 |



*Prepared health drink*

**Viscosity**

Viscosity of the formulations increased progressively with increasing concentration of chia seeds. This is attributed to the presence of soluble dietary fibers and mucilage in chia seeds, which absorb water and form a gel-like network. Formulations F1 and F2 showed low viscosity, resulting in a thin consistency. In contrast, F4 and F5 exhibited higher viscosity, providing improved mouthfeel and satiety. However, excessive viscosity in F5 may reduce ease of consumption. Therefore, F4 demonstrated optimal viscosity, balancing thickness and drinkability.

**Table 7: Viscosity of Formulations**

| Formulation | Viscosity (cP) (Mean ± SD) |
|---|---|
| F1 | 120 ± 5 |
| F2 | 150 ± 6 |
| F3 | 180 ± 7 |
| F4 | 220 ± 8 |
| F5 | 260 ± 10 |

**Sedimentation Study**

Sedimentation studies indicated that formulations containing lower concentrations of chia seeds showed slight settling of particles over time, indicating reduced stability. As the chia concentration increased, sedimentation decreased due to the formation of a stable gel matrix.

Formulations F4 and F5 exhibited minimal to no phase separation, confirming better physical stability. The presence of stabilizers further enhanced uniform dispersion and prevented settling. These results indicate that higher chia content improves suspension stability.

**Table 8: Sedimentation Behavior**

| Formulation | Sedimentation Observation | Stability Rating |
|---|---|---|
| F1 | Slight sedimentation | Moderate |
| F2 | Mild sedimentation | Moderate |
| F3 | Minimal sedimentation | Good |
| F4 | No visible sedimentation | Excellent |
| F5 | No sedimentation | Excellent |

**Discussion**

The present study demonstrated that the concentration of chia seeds significantly influences the sensory, physicochemical, and stability properties of the formulated health drink. Organoleptic evaluation indicated that lower concentrations (F1 and F2) showed acceptable taste but lacked desirable texture, whereas higher concentrations improved mouthfeel due to mucilage formation. However, excessive thickness in F5 slightly reduced drinkability. Among all formulations, F4 exhibited the best balance of taste, texture, and overall acceptability.

The pH of all formulations remained within a near-neutral range, indicating good compatibility and suitability for consumption. Viscosity increased with increasing chia concentration due to the water- absorbing and gel-forming properties of chia mucilage. Sedimentation studies revealed that higher chia content improved physical stability by preventing particle settling.

Stability studies showed that formulations stored under refrigerated conditions remained stable with minimal changes in pH, taste, and physical appearance, while slight variations were observed at room temperature. Overall, formulation F4 was identified as the optimized formulation, providing optimal viscosity, stability, and sensory acceptability.

**5. Summary and Conclusion**

**Summary**

The present study focused on the formulation and evaluation of a chia-based health drink using *Salvia hispanica L.* as a functional ingredient. Chia seeds are recognized for their rich nutritional profile, including omega-3 fatty acids, dietary fiber, proteins, minerals, and bioactive phytochemicals, making them highly suitable for nutraceutical applications. The study aimed to develop a palatable, stable, and nutritionally enriched beverage by incorporating varying concentrations of chia seeds along with sweeteners, flavoring agents, and stabilizers.

The formulation process involved pre-soaking chia seeds to utilize their mucilage-forming ability, followed by dispersion in a liquid medium such as water or milk. Multiple formulations (F1–F5) were prepared by altering chia concentration and excipient composition to optimize sensory and physicochemical properties.

Evaluation parameters included organoleptic characteristics, pH, viscosity, and sedimentation behavior. Results indicated that increasing chia concentration enhanced viscosity, texture, and stability due to gel formation, while maintaining acceptable pH levels. Organoleptic analysis revealed that formulations with moderate chia content showed

better balance in taste, texture, and overall acceptability. Stability studies confirmed that the formulations remained stable under refrigerated conditions with minimal changes over time.

**Conclusion**

The study successfully developed and evaluated a chia-based health drink with promising functional and nutritional benefits. Among all formulations, F4 was identified as the optimized formulation, offering the best balance between viscosity, stability, and sensory acceptability. The results confirmed that chia seed concentration plays a crucial role in determining the overall quality and performance of the formulation.

The near-neutral pH, improved viscosity, and enhanced stability highlight the suitability of chia seeds as a natural thickening and stabilizing agent in beverage formulations. Additionally, the presence of bioactive compounds in chia seeds contributes to the potential health benefits of the developed product.

Chia-based health drinks represent a viable and effective approach for delivering functional nutrition. Such formulations can be further explored for large-scale production and commercialization as nutraceutical beverages aimed at promoting health and preventing lifestyle-related diseases.

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