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# Utilization of Aloe Vera Gel and Chia Seed Gel As An Egg Substitute in the Preparation of Muffins

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**ABSTRACT**

Aloe Vera and Chia seed has gained immense attention due to their nutritional and Health benefits. In recent years, egg is replaced by various food products, to make sure that vegan people can eat it. This project aims to develop Vegan Muffins in which egg is replaced by Aloe Vera gel and Chia seed gel which would not only enhance the structure and nutritional profile of the product but also appeal to the health-conscious of consumer. Healthy Vegan Muffins were prepared comprising of ingredients Aloe Vera gel, Chia seed gel, wheat flour, sugar powder, Almond milk, vegetable oil, baking powder, baking soda, salt. The study employed a combination of sensory evaluation and chemical analysis to determine the quality characteristics Vegan muffins, such as moisture content, ash content, protein content, carbohydrate content, texture profile analysis. Additionally, the effect of Aloe Vera and Chia seed gel on the texture, flavor, and overall acceptability of the Muffins were examined. The results showed that the Aloe Vera and Chia seed gel Muffins had a positive effect on the nutritional profile as it increased the protein, fiber content. The sensory evaluation revealed that the Chia seed Muffins had the highest overall acceptability score.

**Keywords:** *Aloe Vera Gel*, Chia Seed Gel, Vegan Muffins, Overall acceptability, Physical analysis, Proximate analysis, Texture profile analysis, Sensory Evaluation.

## Chapter1
## Introduction
### 1.1.History of Muffins

A muffin is an individually baked product derived from the French word moufflet which is applied to bread and means soft. English muffins are flat with nooks and crannies that are crooked.

English muffins originating in London were made from yeast dough, in contrast to the quick bread muffins served in early America. Muffins are described as a quick bread since “quick- acting” chemical leavening agents are used instead of yeast, a “longer acting” biological leavening agent. Muffins have become increasingly popular as a hot bread served with meals or eaten as a snack. Freshly baked muffins are served in restaurants and bakeries, and consumers can buy packaged ready-to-eat muffins from grocery stores and vending machines. With the availability of dry mixes, frozen muffin batter, and pre deposited frozen muffins available on the wholesale market, it is possible for restaurants and small bakeries to serve a muffin of a consistently high quality.

Amounts of sugar in muffins range from 50 to 70% based on flour at 100%. Sugar contributes tenderness,

crust color and moisture retention in addition to a sweet taste. Sucrose promotes tenderness by inhibiting hydration of flour proteins and starch gelatinization. Sugar is hygroscopic (attracts water) and maintains freshness. Corn syrup, molasses, maple syrup, fruit juice concentrates and honey are used as sweeteners for flavor variety. Honey or molasses is often used as a sweetener in whole wheat or bran muffins to cover the bitter flavor of the bran. The quantity of liquid will need to be decreased if these sweeteners are used instead of sucrose because of the high-water content in these syrups. Chemical changes in sugars during baking contribute characteristic flavors and browning.

**Fig.1.Muffins**

Muffins contain 18-40% fat based on flour at 100%. Fat contributes to the tenderness, flavor, texture, and a characteristic mouthfeel. Fat keeps the crumb and crust soft and helps retain
moisture and thus contributes to keeping qualities or shelf life. Fat enhances the flavor of baked products since flavor components dissolve in fat. Both shortening and vegetable oils are used in muffins. To meet the demands of the consumer, muffin formulas are being
modified to reduce total fat, saturated fat, trans fat and calories and to increase the amount of monounsaturated and polyunsaturated fat. Low fat and fat free muffins are available ready- to-eat and as frozen batters or dry mixers.

**1.1.1 Cupcakes and Muffins**

Cupcakes are made from flour, sugar (or any other sweetening agent), binding agent like egg, gluten, starch, fat like butter, margarine, shortening, fruit puree; liquid like milk, water, fruit juice, flavors and leavening agent like baking powder or yeast. Cupcakes do not contain nuts and fruits. Cupcake is food that is often baked and very sweet
Muffins have more or less all ingredients used in cakes but the proportion is different. There is more flour, more liquid, less sugar and fat in muffin batter. Most cakes need two or more eggs while muffins use only one. Baking powder is used for batter rise but yeast is never used in muffins. Extra ingredients in the form berries etc are added. Thus, the muffin is heavier (nutrition wise) than a cup cake. Muffins are not too sweet.

**1.2.Aloe Vera**

The Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. The name Aloe Vera derives from the Arabic word “Alloeh” meaning “shining bitter substance,” while “Vera” in Latin means “true.” 2000 years ago, the Greek scientists regarded Aloe Vera as the universal panacea.

**Fig.2.Aloe Vera**

The Egyptians called Aloe "the plant of immortality." Today, the Aloe Vera plant has been used for various purposes in dermatology**.**

The botanical name of Aloe Vera is Aloe barbadensis miller. It belongs to Asphodelaceae (Liliaceae) family, and is a shrubby or arborescent, perennial, xerophytic, succulent, pea- green color plant. It grows mainly in the dry regions of Africa, Asia, Europe and America. In India, it is found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu.

**Active components with its properties**: Aloe Vera contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids.4–6

**Vitamins:** It contains vitamins A (beta-carotene), C and E, which are antioxidants. It also contains vitamin B12, folic acid, and choline. Antioxidant neutralizes free radicals.

**Enzymes**: It contains 8 enzymes: aliiase, alkaline phosphatase, amylase, bradykinase, carboxypeptidase, catalase, cellulase, lipase, and peroxidase. Bradykinase helps to reduce excessive inflammation when applied to the skin topically, while others help in the breakdown of sugars and fats.

**Minerals:** It provides calcium, chromium, copper, selenium, magnesium, manganese, potassium, sodium and zinc. They are essential for the proper functioning of various enzyme systems in different metabolic pathways and few are antioxidants.

**Sugars:**It provides monosaccharides (glucose and fructose) and polysaccharides: (glucomannans/polymannose). These are derived from the mucilage layer of the plant and are known as mucopolysaccharides. The most prominent monosaccharide is mannose-6-phosphate, and the most common polysaccharides are called glucomannans [beta-(1,4)-acetylated mannan]. Acemannan, a prominent glucomannan has also been found. Recently, a glycoprotein with antiallergic properties, called alprogen and novel anti-inflammatory compound, C-glucosyl chromone, has been isolated from Aloe vera gel.

**Anthraquinones:** It provides 12 anthraquinones, which are phenolic compounds traditionally known as laxatives. Aloin and emodin act as analgesics, antibacterials and antivirals.

Fatty acids: It provides 4 plant steroids; cholesterol, campesterol, β-sisosterol and lupeol. All these have anti-inflammatory action and lupeol also possesses antiseptic and analgesic properties.

**Hormones**: Auxins and gibberellins that help in wound healing and have anti-inflammatory action.

**Others:** It provides 20 of the 22 human required amino acids and 7 of the 8 essential amino acids. It also contains salicylic acid that possesses anti-inflammatory and antibacterial properties. Lignin, an inert substance, when included in topical preparations, enhances penetrative effect of the other ingredients into

the skin. Saponins that are the soapy substances form about 3% of the gel and have cleansing and antiseptic properties.

**1.3.Chia Seeds:**

Chia seeds are the tiny black seeds of the chia plant (*Salvia hispanica*).Native to Mexico and Guatemala, they were a staple food for the ancient Aztecs and Mayans. In fact, "chia" is the ancient Mayan word for "strength"

Chia seeds are small, flat, and oval-shaped with a shiny and smooth texture. Their color ranges from white to brown or black.These seeds are highly versatile. They can be soaked and added to porridge, made into pudding, used in baked goods, or simply sprinkled on top of salads or yogurt.Because of their ability to absorb liquid and form a gel, they can also be used to thicken sauces or as an egg replacement.

**Fig.3.Chia seeds**

Chia seeds contain 138 calories per ounce (28 grams).

- **Calories:** 486
- **Water:** 6%
- **Protein:** 16.5 grams
- **Carbs:** 42.1 grams
- **Sugar:** 0 grams
- **Fiber:** 34.4 grams
- **Fat:** 30.7 grams
  - **Saturated:** 3.33 grams
  - **Monounsaturated:** 2.31 grams
  - **Polyunsaturated:** 23.67 grams
  - **Omega-3:** 17.83 grams
  - **Omega-6:** 5.84 grams
  - **Trans:** 0.14 gram

Notably, chia seeds are also free of gluten.

More specifically, these common egg substitutes are carbohydrate molecules, called polysaccharides, that are made up of long chains of sugar molecules. At the molecular level, these polysaccharides are very different from the proteins and fats found in eggs.

Long before Chia seeds were known for its amazing health benefits, it was used to create textiles. Now they have become a staple in the world of healthy eating due to their high omega-3 fatty acids and fiber

content. Some people also refer to them as “functional food,” which means food that can boost health. Tiny brown seeds are known to improve digestion, reduce risk of heart disease, type 2 diabetes, and cancer. Chia seeds are expensive and less in calories as compared to other nuts but are also extremely nutritious.

## 1.4.Raw Materials

### 1.4.1.Aloe Vera Gel

Aloe Vera gel is rich in unique polysaccharides, which are long chains of natural sugars that researchers believe give aloe its many skin-healing properties. What's more, it's rich in various vitamins and minerals, including vitamins A, C, and E, which can help promote wound healing and healthy skin.

**Fig.4.Aloe Vera Gel**

One less-known use of Aloe Vera is as a food ingredient. The plant makes its way into commercial food products including yogurts and desserts. Your recipes and drinks can take advantage of its unique and subtle flavor profile: a slightly bitter initial taste followed by a gentle sweetness.

Aloe Vera is a popular medicinal plant with antioxidant and antibacterial properties. It may be useful for reducing dental plaque, accelerating wound healing, preventing wrinkles, and managing blood sugar, among other benefits.

### 1.4.2.Chia Seed Gel

Chia seed gel can accomplish the same goals as eggs it can act as a binder in baked goods and other recipes like veggie burgers, add moisture to baked goods and help baked goods rise. As Chia seed have lecithin it can be used in ice creams as an emulsifier.

**Fig.5.Chia Seed Gel**

### 1.4.3.Wheat flour

Wheat is the most abundant food crop, based on the area planted, and it is essentially equal to rice in the

amount harvested. wheat flour will form a viscoelastic dough when mixed with water. The viscoelasticity appears to be because the gluten proteins are water compatible and thus will swell and interact. The gluten protein's large molecular size and low charge density appear to allow them to interact by both hydrogen and hydrophobic bonds.

**Fig.6.Wheat Flour**

Wheat flour doughs are also unique in their ability to retain gas. This property appears to result from a slow rate of gas diffusion in the dough. The third major unique property of wheat flour doughs is their ability to set in the oven during baking, and thereby to produce a rigid loaf of bread. Although not clearly understood, this appears to be a heat-induced crosslinking of the gluten proteins (Rogers, D. E. (1990)).

**1.4.4.Vegetable Oil**

Vegetable oils, or vegetable fats, are oils extracted from seeds or from other parts of fruits. Like animal fats, vegetable fats are mixtures of triglycerides. Soybean oil, grape seed oil, and cocoa butter are examples of seed oils, or fats from seeds. Olive oil, palm oil, and rice bran oil are examples of fats from other parts of fruits. In common usage, vegetable oil may refer exclusively to vegetable fats which are liquid at room temperature. Vegetable oils are usually edible.

Vegetable oil contributes moistness far more reliably, a result of the fact that oil remains liquid at room temperature while butter solidifies. Liquid contributes to the sensation of moistness, and therefore cakes made with oil often present as moister than their butter-based counterparts.

**Fig.7.Vegetable oil**

Probably the biggest function of oil in most baking recipes is to keep your product moist. It basically captures the gases that are released from the interaction of the baking powder and baking soda, and slows down gluten formation to keep certain baked goods tender and fluffy in texture

**1.4.5.Sugar Powder**

Powdered sugar, also called confectioners' sugar, or icing sugar, is a finely ground sugar produced by milling granulated sugar into a powdered state. It usually contains between 2% and 5% of an anti-caking

agent – such as corn starch, potato starch or tricalcium phosphate to absorb moisture, prevent clumping, and improve flow. Although most often produced in a factory, a proxy for powdered sugar can be made by processing ordinary granulated sugar in a coffee grinder, or by crushing it by hand in a mortar and pestle.

**Fig.8.Sugar powder**

Powdered sugar can be used for several purposes in baked goods: Sweetener: provides a sweet flavor. Tenderizer: interferes with gluten formation, protein coagulation and starch gelatinization. Shelf life improvement: reduces the amount of water available for microbial deterioration.

**1.4.6.Almond Milk**

Almond milk is a plant-based beverage made from filtered almonds and water. It is naturally dairy- and lactose-free, making it a good option for those avoiding dairy.

Almond milk has no lactose (a type of sugar found naturally in dairy milk) since it's not an animal product. As a result, it's a good milk substitute for people with lactose intolerance. It's also suitable for people who are vegan (don't eat animal products).

**Fig.9.Almond Milk**

It’s a good source of magnesium. Almond milk is rich in magnesium, a mineral that many American diets fall short on. Magnesium is important for muscle function, blood sugar control, blood pressure, and making bone, protein, and DNA.

It’s rich in antioxidant vitamin E. Almond milk is a good source of vitamin E, which is important for your immune system and blood vessels. Some studies have shown a link between high vitamin E intake and a lower risk of cognitive diseases like Alzheimer’s disease. Vitamin E is an antioxidant, which protects your cells from the effects of dangerous molecules called free radicals.

**1.4.7.Baking powder**

Baking powder is a two-in-one chemical leavening that combines a powdered alkali (sodium bicarbonate) with a powdered acid (originally, tartaric acid). When moistened in a dough or batter, a chemical reaction

takes place that produces carbon dioxide gas, inflating cookies, cakes, and pancakes.


**Fig.10.Baking powder**

Because baking powder combines both an acid and a base, it eliminates the need for ingredients like buttermilk or sour cream to activate the sodium bicarbonate, allowing milk or even water to set off the reaction.

Baking powder is a dependable, high-quality chemical leavener. To be effective, all baking powders rely on the reaction between one or more acids on sodium bicarbonate to produce carbon dioxide gas. Just as with yeast leavening, the presence of carbon dioxide gas creates air bubbles that cause the product to rise.

**1.4.8Baking Soda**

Baking soda is an alkaline compound that, when combined with an acid, will produce carbon dioxide gas. The small bubbles of carbon dioxide gas become trapped in batter, causing it to inflate, or rise.

Baking soda will also produce gas upon decomposition caused by heat. No acid is necessary for this reaction to take place, only exposure to temperatures above 80 degrees Celsius.


**Fig.11.Baking soda**

## 1.5 Objective

- To extract and incorporation of Aloe Vera gel and Chia seed gel in the cake preparation as an egg substitute.
- To develop and study the textural properties of product using different ratios of Chia seed and Aloe Vera gel.
- To study the physico-chemical properties of the developed product.

## Chapter 2

## Review of literature

The study, vegan Muffins using Aloe Vera gel and Chia seed Gel as a substitute of egg provides us information on Nutritional aspects, textural properties. Aloe Vera is a succulent plant. Succulents are xerophytes, which are adapted to living in areas of low water availability and are characterized by

possessing a large water storage tissue. The main feature of the Aloe Vera plant is its high water content, ranging from 99–99.5%.[4] The remaining 0.5–1.0% solid material is reported to contain over 75 different potentially active compounds including water- and fat-soluble vitamins, minerals, enzymes, simple/complex polysaccharides, phenolic compounds, and organic acids. In compositional studies on the structural components of the Aloe Vera plant leaf portions, the rind was found to be 20–30% and the pulp 70–80% of the whole leaf weight. On a dry weight basis, the percentages of the rind and pulp represented as lipids (2.7% and 4.2%) and that as proteins (6.3% and 7.3%) only accounted for a minor fraction.[5] However, the non starch polysaccharides and lignin represented the bulk of each leaf fraction and were found to be 62.3% and 57.6% of the dry weight of the rind and pulp, respectively. Aloe Vera gel polysaccharides consist of linear chains of glucose and mannose molecules, of which mannose is more concentrated than glucose, thereby the molecules are referred to as polymannans.[6] These are linear chains ranging in size from a few to several thousand molecules.[7] The major polysaccharide, acemannan, is composed of one or more polymers of various chain lengths with molecular weights ranging from 30 kDa to 40 kDa or greater, and consisting of repeating units of glucose and mannose in a 1:3 ratio.( Panel Maharjan H. Radha, Nampoothiri P. Laxmipriya (2015))

Chia Seeds (*Salvia hispanica* L.) is a small seed that comes from an annual herbaceous plant, *Salvia hispanica* L. In recent years, usage of Chia seeds has tremendously grown due to their high nutritional and medicinal values. Chia was cultivated by Mesopotamian cultures, but then disappeared for centuries until the middle of the 20th century, when it was rediscovered. Chia seeds contain healthy ω-3 fatty acids, polyunsaturated fatty acids, dietary fiber, proteins, vitamins, and some minerals. Besides this, the seeds are an excellent source of polyphenols and antioxidants, such as caffeic acid, rosmarinic acid, myricetin, quercetin, and others. *Salvia hispanica* L., also known as chia, is an annual herbaceous plant, originally from Southern Mexico and Northern Guatemala. It belongs to the order Lamiales, mint family Labiate, subfamily Nepetoideae, and genus *Salvia*. The genus *Salvia* consists of approximately 900 species, which have been widely distributed for thousands of years around several regions of the world, including Southern Africa, Central America, North and South America, and South-East Asia .As reported in the literature, chia today is not only cultivated in Mexico and Guatemala, but also in Australia, Bolivia, Columbia, Peru, Argentina, America, and Europe. Nowadays, Mexico is recognized as the world's largest chia producer.

Muffins contain flour, liquid, sugar, salt, shortening, and baking powder. The liquid, usually milk, represents about half the amount of flour on a volume basis, and it approximately equals the amount of flour on a weight basis. The amounts of sugar, and shortening are low in a basic muffin formula as compared with the proportions in a cake; therefore, muffin batter cannot tolerate the amount of mixing to which cake batters are subjected. The mixing method that is referred to as the muffin method was developed for the purpose of permitting minimal mixing. It involves stirring a mixture of milk, egg, and oil or melted shortening into the combined dry ingredients. A satisfactory alternative is cutting the fat rather finely into the dry ingredients and then adding milk and egg mixture. In either case, mixing the ingredients of a basic muffin should be just sufficient after the liquid is added to dampen the dry ingredients; the batter should not be smooth.

Muffins from properly mixed batter rise evenly and well during the early part of the baking period because the batter contains many gas cells in readily extensible gluten. They are large and symmetrical, without peaks, and their crust is pebbled rather than rough or smooth. They have a fairly even, open grain, without tunnels. They are tender. Overmixing decreases tenderness and produces a muffin with a crust that is light

in color, smooth, and peaked, with tunnels that go toward the peak, and with a fine grain between the tunnels. Properly mixed and overmixed muffins are shown below.

The outbreak of coronavirus disease (COVID-19) has acted as a massive restraint on the bakery and confectionary market in 2020 as supply chains were disrupted due to trade restrictions and consumption declined due to lockdowns imposed by governments globally. The outbreak had a negative impact on businesses throughout 2020 and into 2021. However, it is expected that the bakery and confectionary market will recover from the shock over the forecast period and not related to ongoing market in the global economy.

The global bakery & confectionary market grew from $870.93 billion in 2021 to $943.68 billion in 2022 at a compound annual growth rate (CAGR) of 8.4%. The bakery & confectionary market is expected to grow to $1,163.52 billion in 2026 at a CAGR of 5.4%.

The bakery industry in India is the largest of the food processing segments with an estimated annual turnover of about $ 7.60 billion in 2020. The biscuits and cookies industry accounts for nearly 72% of the sales in the Indian bakery market.

Indian bakery market was worth $ 7.22 billion in 2018. The market value is projected to reach a value of $ 13.3 billion by 2025, expanding at an annual compound rate of 9.1% during the period.

The organic bakery products, due to their high nutrient value and affordability, have now become an item of huge consumption which has also shown a strong demand growth for bakery products in India. The growth of an industry also brings in its own challenges and the most important of them is to expand production capacity to meet the new age demands. For example, to meet the demand for healthier food, bakery store or shop need to invest in making the facilities more hygienic and also hiring new people with knowledge of such products

## Chapter 3
## Materials and Methodology
### 3.1.Development of Muffins
#### 3.1.1Preparation of Aloe Vera Gel

Aloe Vera is a plant species with several medicinal and nutritional values. The plant has green colored, gel-filled leaves. Many people use the gel to treat burns and wounds, and it is available as a juice. Aloe Vera grows abundantly in tropical climates and has been used for centuries as a medicinal plant. Aloe Vera leaves contain phytochemical. Aloe Vera gel is the mucilaginous jelly obtained from parenchyma cells of the Aloe Vera plant. After harvesting of aloe Vera leaves they are crushed, grinded, filtered and stabilized to get aloe gel.

The entire process involves washing the freshly harvested Aloe Vera leaves in a suitable way, followed by processing of the leaves to mechanically separate the gel matrix from the outer cortex. The separation of the gel from the leaf could be facilitated by filtering the mucilage through muslin cloth. Thus, the aloe liquid obtained is treated with activated carbon to decolourize the liquid and remove Aloin, which have laxative effects. The resultant liquid is centrifuged at 6000 rmp, for 20 min thus, obtained could be concentrated to reduce the amount of water or, alternatively, almost all of the water removed to yield a powder.

Fig.12.Aloe Vera Gel

**Washing of Aloe Vera**

↓

**Trimming**

↓

**Separation of Mucilage**

↓

**Purification**

↓

**Centrifuge – 6000 rpm, 20 mins**

↓

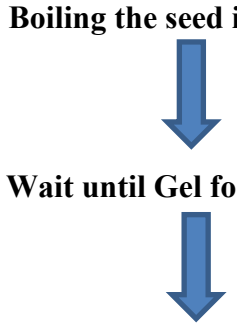
**Filleting**


**Flow Chart 1:-Preparation of Aloe Vera Gel**

### 3.3.Preperation of Chia seed Gel

Chia seed gel can accomplish the same goals as eggs it can act as a binder in baked goods and other recipes like veggie burgers, add moisture to baked goods and help baked goods rise. As Chia seed have lecithin it can be used in ice creams as an emulsifier.

Boil the water on medium heat. The Chia seeds are cleaned in water to remove dust. One spoon seeds are boiled in one cup of water. The boiling is continued until the mucilage is formed. Reduce heat to medium-low and let simmer until a gel consistency is formed. Thus the gel formed is filtered through muslin cloth and let it cool.




**Flow Chart 2:-Preparation of Chia seed Gel**


**Flow chart 3: Pictorial representation of Preparation of Chia seed Gel**

### 3.4.Selection of ingredients

The necessary ingredients required for the development of Muffins are obtained by ensuring all ingredients are fresh and in appropriate conditions

| S.NO | Ingredients |
|---|---|
| 1 | Aloe Vera gel |
| 2 | Chia seed gel |
| 3 | Wheat flour |
| 4 | Sugar powder |
| 5 | Almond Milk |
| 6 | Baking powder |
| 7 | Baking soda |
| 8 | Vegetable oil |
| 9 | Salt |

**Table 1:- Ingredients used in Muffins**

### 3.5Preparation of Muffins

#### 3.5.1Control sample

Control sample was prepared from the traditional ingredients that are used for the preparation of Muffins. All the required dry ingredients for control sample were carefully examined and selected. They are then weighed and sifted separately using the sieve of same mesh size to form uniform particle size in the final product. After sieving all the dry ingredients are mixed together and sifted again altogether for final checking. The prepared batter is then shifted to cups and baked at 180°C for 20 mins.

| S. No | Ingredients | Weights grm |
|---|---|---|
| 1 | Wheat flour | 50 |
| 2 | Sugar | 40 |
| 3 | Vegetable oil | 40 |
| 4 | Almond milk | 20 |
| 5 | Baking powder | 1.25 |
| 6 | Baking soda | 125 |
| 7 | Salt | 0.5 |

**Table 2:- Composition of Ingredients in Control Sample**

### 3.5.2.Aloe Vera and Chia seed gel incorporated samples

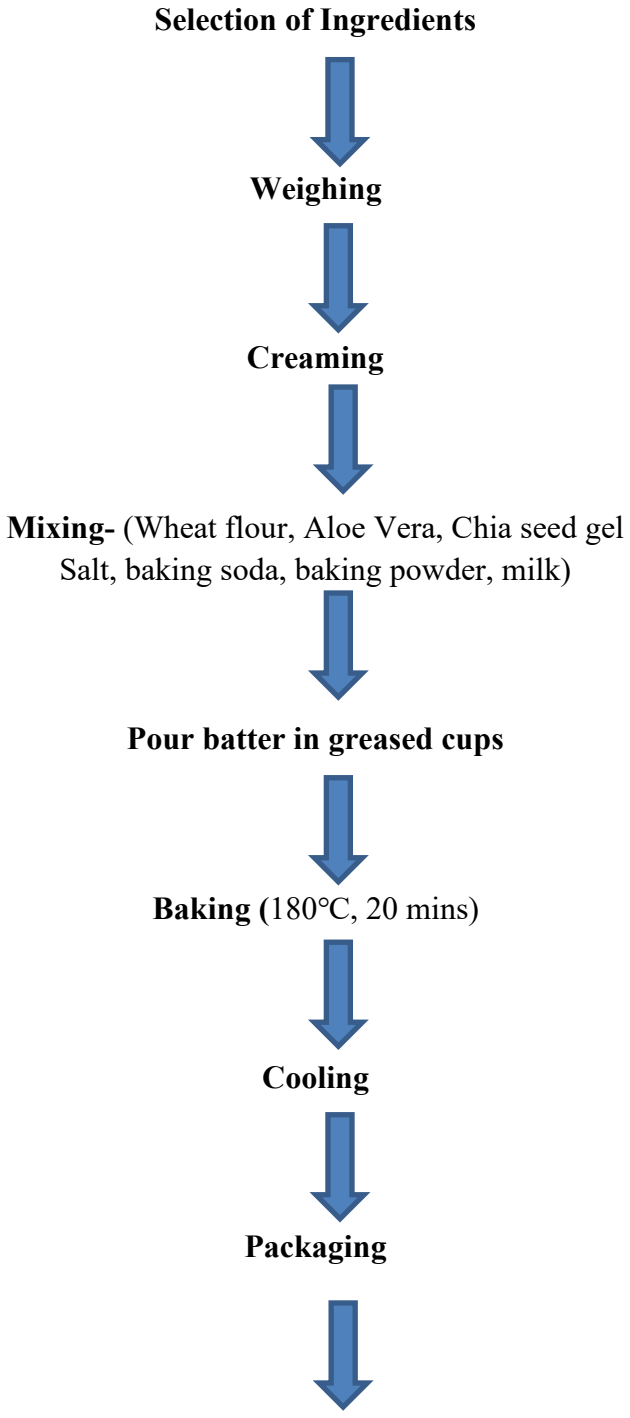
Muffins are produced in Five different samples, which sample one consist of only Aloe Vera gel, sample 2 consist of only Chia seed gel, sample 3 consist of equal amounts of Aloe Vera and Chia seed gel, sample 4 consist of more content of Chia seed gel and less content of Aloe Vera gel and sample 5 consist of more content of Aloe Vera gel and less content of Chia seed gel.

These muffins are prepared by using vegetable oil and Almond milk. Because the main goal of the project is preparing vegan Muffins. So vegetable oil and almond milk are completely vegan products. These muffins does not contain an animal based products, so these muffins are very suitable for vegetarians.

Five different samples were prepared with different ratios of Aloe Vera and Chia seed Gel. At first creaming is done, beating sugar and oil together until they are lightened in color and fluffy. Then followed by adding all the dry ingredients like wheat flour, salt, baking powder and baking soda. Add the Aloe Vera and Chia seed gel according to ratios in ever sample and add Almond milk for better consistency. And then pouring the batter into cups and keeping in oven. Before stating the process preheat the oven. Keep the batter samples in oven at 180℃ for 20 mins.

| Ingrediants | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 |
|---|---|---|---|---|---|
| Wheat flour (gm) | 50 | 50 | 50 | 50 | 50 |
| Oil (ml) | 10 | 10 | 10 | 10 | 10 |
| Sugar (gm) | 40 | 40 | 40 | 40 | 40 |
| Aloe Vera gel (ml) | 30 | | 15 | 10 | 20 |
| Chia seed gel (ml) | | 30 | 15 | 20 | 10 |
| Almond milk (ml) | 10 | 10 | 10 | 10 | 10 |
| Baking powder (gm) | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Baking soda (gm) | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Salt (gm) | 0.5 | 0.5 | 0.5 | 0.5 | 05 |

**Table 3:- Muffins Formulation**




**Flow Chart 3:-Preparation of Muffins**

**Flow chart 4:- Pictorial representation of Preparation of Muffins**

**Fig.13.creaming**

**Fig.14.Mixing**

**Fig.15.Molding**

**Fig.16.Baking**

**Fig.17.Muffins**

### 3.6.Preliminary Trails

These are the 6 samples prepared

**Fig.18.Control Sample**

**Fig.19.Sample 1**

**Fig.20.Sample 2**

**Fig.21.Sample 3**

**Fig.22.Sample 4**

**Fig.23.Sample 5**

## Chapter 4
## ANALYSIS

### 4.1. Proximate analysis

Proximate analysis is the process of determination of the presence of different compounds and their amounts in a mixture**.** This concept of proximate analysis was developed by Henneberg and Stohmann (German scientists) in 1860.

#### 4.1.1. Determination of Moisture content

Principle:

The moisture content is the loss in the weight of water when heated under specified conditions. The moisture content in Muffins was determined and calculated gravimetrically by using AOAC method (2005).

Equipment used: Hot Air OvenApparatus: Petri plates

Weighing balance

Procedure:

To determine the moisture content of the sample, first take a clean dried Petri plate and weigh the empty petri plate. Now add the sample to it and note the weight.

1. Place the petri dish with sample in the hot air oven at 135℃ for 2hrs.
2. Cool the petri plate in the desiccator, which helps to prevent the moisture absorption by sample from the external environment.
3. Take the final weight of the petri plate and calculate the moisture content of the sample withthe formula.

$$\%MC_{wb} = \frac{W_s - (W_2 - W_1)}{W_s} \times 100$$

$$\%MC_{db} = \frac{\%MC_{wb}}{100 - \%MC_{wb}} \times 100$$

Where,
$Cb$ = Moisture content in wet basis
$Cb$ = Moisture content in dry basis
$s$ = Weight of the wet sample
1 = Weight of the petri plate
2 = Weight of the dry sample + petri plate

**Fig.24.Before Drying**

**Fig.25.After Drying**

**4.1.2.Determination of Ash content**

Principle:

Total ash is the inorganic residual remaining on incineration in a muffle furnace. This reflects the quantity of mineral matter present in the sample. The total ash in the Muffins was estimated using the method (*Raghuramulu, 2003*).

Equipment used: Muffle furnaceApparatus: Crucible

Weighing balanceTongs

Procedure:

1. Dry the crucible at 105℃ for 20 minutes, cool it in the desiccator.
2. Weight the empty crucible

3. Add sample (2-6g) into the crucible and note the weight and cover with lid
4. Place the crucible in the muffle furnace at the temperature 500℃-700℃ for 2hrs.
5. Take the crucible out at below 250℃ only using heat resistant gloves.
6. Cool the crucible in the desiccator.
7. Take the final weight of the crucible and calculate the percentage of the ash content.

$$\text{Percentage of ash content} = \frac{W_2 - W_1}{W_s} \times 100$$

Where,
$W_2$= weight of crucible with ash $W_1$= weight of crucible
$W_S$= weight of sample

**Fig.26. Muffle furnace**

### 4.1.3.Determination of Fat content

The fat content present in the Muffins was determined according to standard AOAC 948.22 (2012) Soxhlet apparatus is used to determine the crude fat content of the sample. It consists of thimble preparation, sample preparation, fat extraction and calculating the final weight.
Equipment used: SOCSPLUS SCS 04E(soxhlet apparetus)
Hot air ovenApparatus: weighing balance
Procedure:

- **Thimble Preparation**
  - Take a filter paper and make thimble by stapling one end.
- **Sample Preparation**
  - Take 5g of sample and place cotton into thimble and close opening end of thimble.
  - Place this in the cellulose thimble.
  - Take the empty weight of flat bottom flask.
- **Fat Extraction**
  - Place the thimble in the Soxhlet apparatus and add sufficient amount of nhexane.
  - Turn on power, cold-water supply and run the apparatus.
  - Reflux rate of the extractor is 5 drops per second.
  - Run the apparatus for 6 hours.

- **Taking Final weight**
- Place the flask in the hot air oven at 110℃ for 30 min to evaporate excess solvent, cool it.
- Take final weight of the flask with fat.
- The total content of the fat is determined by the formula

$$\text{Crude Fat\%} = \frac{W_2 - W_1}{W_s} \times 100$$

Where,
$W_2$= Fat + flask weight $W_1$= empty flask weight$W_S$= weight of sample

**Fig.27.Soxhlet Apparatus**

### 4.1.2. Determination of Protein content

Principle:
The nitrogen in protein or any other organic material is converted to ammonium sulfate by $H_2SO_4$. during digestion. This salt, on steam distillation, liberates ammonia which is collected in boric acid solution and titrated against standard acid. Since 1 ml of 0.1N acid is equivalent to 1401 mg, the calculation is made to arrive at the nitrogen content of the sample. (AOAC, 2000)
Equipment: Digestion unit (KELPLUS ES06LE) Distillation unit (KELPLUS DISTYL-EMS)
Apparatus: Beakers
Conical flaskBurette
Weighing balance Measuring cylinderBurette stand
Reagents used: Copper sulphate
Potassium sulphateBoric acid Sulphuric acid Sodium hydroxideHydrochloric acid
Procedure: 1.Digestion

- Take 1.5-2 g of sample in a labelled Kjeldahl flask.

- Weigh 2g of catalyst (potassium sulphate + copper sulphate + selenium dioxide) and add it intothe flask.
- Add 20ml of concentrated sulfuric acid by a pipette and mix it.
- Place the flask in the digestion unit at 230℃ for 2hours and cool the flask at room temperature.
- Distillation
  - Measure 30ml of 4% of boric acid into the conical flask.
  - Place it in the distillation unit.
  - Take 10 ml of digested sample into distillation flask.
  - Add 15ml of 40% sodium hydroxide which turns into blue colour.
  - Add another 50ml of distilled water and heat at 200℃.
  - Collect 100ml of distillate

**Titration**

- Take 0.1 N HCl in burette and note down the initial reading.
- Add few drops of methyl red indicator into the distillate which changes transparent colour of the distillate into yellow colour.
- Start titration until colour changes into orange.
- Note the final reading of the burette.
- Calculate the nitrogen content and crude protein of the sample using the below formula.

Calculation:

$$\% \text{ Nitrogen} = \frac{\text{Vol of 0.1 N Hcl} \times \text{Normality of HCl} \times \text{Acid factor of HCl} \times \text{Mwt of } N_2}{\text{Sample weight} \times 10}$$

$$\% \text{ Crude protein} = \text{N\%} \times 6.25 \text{ (conversion factor)}$$

**Fig.28. Digestion**

**Fig.29.Distillation**

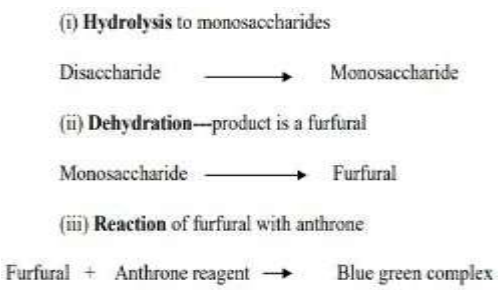
**Fig.30.Titration**

**4.1.3Determination of carbohydrate content**

Principle:

Carbohydrates are dehydrated by conc.H2SO4 to form furfural. Active form of the reagent is anthranol, the enol tautomer of anthrone, which reacts by condensing with the carbohydrate furfural derivative to give a green colour in dilute and a blue colour in concentrated solutions, which is determined colorimetrically. The blue - green solution shows absorption maximum at 620 nm.

Reactions:




Equipments: UV Spectrophotomete
Vortex mixer
Mantle heater/Water Bath.
Reagents: Anthrone Glucose Carbohydrates
Apparatus: Test tube,
Test tube stand,Pipettes, Beaker,
Ice Test tube caps,Tissue paper, Wash bottle.
Procedure:

1. Pipette out into a series of test tubes different volumes of glucose solution from the supplied stock solution(200µg /ml) and make up the volume to 1 mL with distilled water.
2. Consider tube 1 as blank and tubes 2 through 9 for construction of a standard curve. Tubes 10-15are for the unknown samples.
3. To each tube add 5 mL of the anthrone reagent (supplied) and mix well by vortexing.
4. Cool the tubes.
5. Cover the tubes with marbles/ Caps on top and incubate at 90o C for 17 minutes or boiling waterbath for 10 minutes.
6. Cool to room temperature and measure the optical density at 620 nm against a blank.
7. Prepare a standard curve of absorbance vs. µg glucose.

**4.2.Sensory evaluation**

Sensory evaluation is a science that measures, analyzes, and interprets the reactions of people to products as perceived by the senses. It is a means of determining whether product differences are perceived, the basis for the differences, and whether one product is liked more than another.

Students and staff in the Department of Food Technology, VFSTR, Vadlamudi, performed sensory analysis with the help of 9-point hedonic scale. The panelists had to sample each product and rate them subjectively on a score ranging from 9 (like extremely) to 1 (dislike extremely) for various attributes such as color, appearance, mouth feel, taste, texture, flavor and overall acceptability.

The sensory evaluation is done for six samples namely Control, Sample 1, Sample 2, Sample 3, sample 4 and Sample 5.

**Table 4 Standard 9-point hedonic scale**

| | |
|---|---|
| 9 | Like extremely |
| 8 | Like very much |
| 7 | Like moderately |
| 6 | Like slightly |
| 5 | Neither like nor dislike |
| 4 | Dislike slightly |
| 3 | Dislike moderately |
| 2 | Dislike very much |
| 1 | Dislike extremely |

**4.3.Physical Analysis**

A physical property is any property that is measurable, whose value describes a state of a physical system. The changes in the physical properties of a system can be used to describe its changes between momentary states. Physical properties are often referred to as observables.

**4.3.1.Weight**

The weight of each sample is taken before and after baking. Weighing balance is used for taking the weights of the sample. Note the weights carefully without any calibration. First note the weights of six samples separately before baking and then note the weights after baking. Label the samples to avoid mistakes.

**4.3.2.Height**

The height of each sample is taken before and after baking. Note the height of each sample batter after pouring into cups using scale and after baking take the height of samples after baking. Label the samples to avoid mistakes.

**4.3.2.Volume Raised**

A volume is simply defined as the amount of space occupied. The batter of starchy products increased and the macroscopic volume is expanding from the effect of the air incorporation (mixing), the production of CO2 either by the synthetic agent or by fermentation (proofing) and the water vaporization (during baking).

Volume raised = [(A-B) / A] *100

Where A = Weight before baking31

B = Weight after baking

**4.4.Texture profile Analysis**

Texture Analysis itself is the study of the deformation and flow of a food when under the influence of stress and includes the assessment of raw materials, intermediate components and finished products. From a manufacturer's perspective, food texture analysis could be assessing the functionality of an ingredient

within the production process or its effect on the finished product. From a customer's perspective, food texture analysis could be a vital assessment to ensure an anticipated or expected sensory property, quality or functional performance of a food. A Texture Analyzer moves in either anup or down direction to compress or stretch a sample. The travelling arm is fitted with a load cell and records the force response of the sample to the deformation that is imposed on it. Force, Distance andTime data is collected and usually presented as a curve on a graph which, when analyzed, indicates the texture of the sample. Texture Analyzers provide the operators with ultimate control and test flexibility for measuring all types of physical/textural properties of solid and semisolid systems by their ability to accommodate a wide range of probes and fixtures that can be attached to the Texture Analyzer base and/or arm. Depending upon the chosen probe/fixture the Texture Analyzer can perform compression, extension, cutting, extruding, bending and shearing tests – and in doing so, canmeasure properties such as fracturability, chewiness, stickiness, consistency, bite force and springiness, to name but a few.

**Fig.31.Texture profile Analyzer**

## Chapter 5
## Results and Discussion
### 5.1.Proximate analysis
#### 5.1.1.Protein content of Muffins

| Sample | Protein % |
|---|---|
| Control sample | 15.25 |
| Sample 1 | 19.25 |
| Sample 2 | 24.5 |
| Sample 3 | 22.05 |

| | |
|---|---|
| Sample 4 | 20.25 |
| Sample 5 | 22.05 |

**Table 4.Protein content of Muffins**

### 5.1.2.Fat content in Muffins

| Sample | Fat content% |
|---|---|
| Control sample | 5.4 |
| Sample 1 | 4.2 |
| Sample 2 | 4.5 |
| Sample 3 | 4.1 |
| Sample 4 | 4.7 |
| Sample 5 | 4.2 |

**Table 5. Fat content in Muffins**

### 5.1.3.Ash content in Muffins

| | |
|---|---|
| **Sample** | **Ash content %** |
| Control sample | 2.64 |
| Sample 1 | 7.48 |
| Sample 2 | 4.25 |
| Sample 3 | 5.48 |
| Sample 4 | 4.32 |
| Sample 5 | 7.6 |

**Table 6. Ash content in Muffins**

### 5.1.4.Moisture content in Muffins

| Sample | Moisture content % |
|---|---|
| Control sample | 25.4 |
| Sample 1 | 22.1 |
| Sample 2 | 24.7 |
| Sample 3 | 23.8 |
| Sample 4 | 22.6 |
| Sample 5 | 21.3 |

**Table 7. Moisture content in Muffins**

### 5.1.5. Carbohydrate content in Muffins

| Sample | Carbohydrate content % |
|---|---|
| Control sample | 28.6 |
| Sample 1 | 40.2 |
| Sample 2 | 32.4 |
| Sample 3 | 35.9 |
| Sample 4 | 30.7 |

| | |
|---|---|
| Sample 5 | 34.6 |

**Table 8. Carbohydrate content in Muffins**

### 5.2.Sensory Analysis

**Table sensory evaluation of Muffins**

| Parameters | Control sample | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 |
|---|---|---|---|---|---|---|
| **Appearance** | 8 | 9 | 9 | 8 | 8 | 8 |
| **Odor** | 8 | 8 | 8 | 8 | 7 | 7 |
| **Taste** | 7.5 | 7 | 8.5 | 8 | 8.5 | 7.5 |
| **Texture** | 8 | 8 | 8 | 8 | 8 | 7 |
| **Chewiness** | 7 | 7 | 8 | 7 | 8 | 7.5 |
| **Overall acceptability** | 7.5 | 7 | 8 | 8 | 8.5 | 7.5 |

**Table 9. Sensory Analysis**

### 5.3.Texture Analysis

The Texture Profile Analysis is performed for all the six samples. The hardness of Muffins was analyzed.

For Control,

Hardness is 18001.94g Gumminess is 12251.39g Chewiness is 4533.19 mJ Cohesiveness is 0.51 Springiness is 0.3mJ

For Sample 1,

Hardness is 25435.19g Gumminess is 14741.98g Chewiness is 8577.01 mJ Cohesiveness is 0.60 Springiness is 0.51 mJ

For Sample 2,

Hardness is 25422.16g Gumminess is 17542.69g Chewiness is 7548.24 mJ Cohesiveness is 0.71 Springiness is 0.53 mJ

For Sample 3,

Hardness is 24314.52g Gumminess is 15843.30g Chewiness is 7505.14 mJ Cohesiveness is 0.73 Springiness is 0.64 mJ

For Sample 4,

Hardness is 3065.71g Gumminess is 24037.22gChewiness is 6432.87 mJCohesiveness is 0.78 Springiness is 0.42 mJ

For Sample 5,

Hardness is 38612.39g Gumminess is 2056.32g Chewiness is 5156.43 mJ Cohesiveness is 0.72 Springiness is 0.32 mJ

## Chapter 6

## Summary and Conclusion

The project aimed to develop the vegan Muffins by incorporating Aloe Vera gel and Chia seed gel as a substitute of egg which are highly nutritious and beneficial ingredient. The study began by assessing the

nutritional composition of Aloe Vera and Chia seeds, identifying its potential health benefits. TheGel was then incorporated into the Muffins at various concentrations, and the resulting products were evaluated for their sensory attributes, nutritional content, and acceptability.

The nutritional analysis revealed that the protein content are high in Chia seed gel Muffins. The results showed that the protein content in Aloe Vera muffins is also more. The fiber content is more in Aloe Vera gel incorporated Muffins when compared to others. Both Aloe Vera and Chia seed Gel maintains the structure of the muffins.

In conclusion, the incorporation of Aloe Vera gel and Chia seed gel in Muffins could provide a healthier alternative to egg by enhancing their nutritional value and maintaining the structure & texture of the muffins and while maintaining their sensory characteristics. By utilizing the exceptional nutritional profile of Aloe Vera and Chia seed gel incorporating it into formulations, consumers can enjoy Muffin that are not only delicious but also enriched with essential vitamins, minerals, antioxidants and Vegan people can enjoy it.

The development of this Vegan Muffins provides a novel approach in substituting the egg with Aloe Vera and Chia seed gel into daily diets. Moreover, this project highlights the versatility of both gels as a functional ingredient in food product development, opening doors for future research and innovation in incorporating this superfood into various culinary applications.

This project shows the potential for innovation in the food industry through the creation of novel products that contribute to a healthier and more diverse functional foods benefiting both consumers and the food industry.

**Chapter 7**

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