DEVELOPMENT OF PROTEIN RICH BURGER BUN INCORPORATED WITH BANANA PITH FLOUR AND FLAXSEED

Dissertation submitted to Mahatma Gandhi University in partial fulfilment of the requirements for the degree of

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B. Voc. Food Processing Technology

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DECLARATION

We, **Ayisha Ziba (VB22FPT006), Dayana Theressa (VB22FPT007)** and **Swetha Sajan (VB22FPT021)** hereby declare that this project entitled **"Development of protein rich burger bun incorporated with banana pith flour and flaxseed"** is a Bonafide record of the project work done by us during the course study and that the report has not previously formed the basis for the award to us for any degree, diploma, fellowship or other title of any other university or society.

Place: Ayisha Ziba

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Date: Swetha Sajan

CERTIFICATE

This is to certify that the project report entitled **"Development of protein rich burger bun incorporated with banana pith flour and flaxseed"** submitted in partial fulfilment of the requirements for the award of the degree of B. Voc. Food Processing Technology of St. Teresa's College, Ernakulam is a record of Bonafide research work carried out by **Ms. Ayisha Ziba, Ms. Dayana Theressa and Ms. Swetha Sajan** under my guidance and supervision and that no part of the project has been submitted for the award of any other degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journal or magazine.

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ABSTRACT

This project explores the innovative development of protein rich burger bun that incorporates banana pith flour and flaxseed, which is aimed at enhancing nutritional value. The major objective of the project is to develop a healthy nutrient-enriched food product in the fast-food category, as today people are more health conscious. The use of banana pith powder, a byproduct of banana cultivation, contributes dietary fiber and potential health benefits, while flaxseed is known for its omega-3 fatty acids and lignans. In the chemical analysis it was found that the banana pith buns contain a good amount of protein. The formulation process involves optimizing the ratios of these ingredients to achieve a desirable texture and flavor profile. Sensory evaluation tests were conducted to assess consumer acceptance, alongside nutritional analysis to highlight the bun's health benefits. In today's world, the word sustainability has its importance in the development processes. Therefore, making food products from underutilized by-products which are abundant in nutrients was the main goal and to further support sustainability. This project underscores the potential of utilizing agricultural byproducts in food production, promoting sustainability and health-conscious eating.

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LIST OF ABBREVIATIONS USED

g	Gram
H_2SO_4	Sulfuric acid
HgO	Mercury Oxide
NH3	Ammonia
ml	Milliliter
Na_2SO_4	Sodium Sulfate
%	Percentage
NaOH	Sodium hydroxide
°C	Degree Celsius
Sp.Gr	Specific gravity
Kcal	Kilocalorie
&	And

CHAPTER I

INTRODUCTION

Fig 1.1 Banana pith

1.1 Importance

Buns are exceptionally tender and airy baked snacks favored across various nations, particularly in developing and middle-income countries. Buns can be consumed on their own or incorporated into the creation of various dishes. Vijayendra, S.V.N., & Sreedhar, R. (2023). The procedure involved in bun production is notably intricate to guarantee the creation of high-quality products, and various ingredients are integrated into the process. Increased health consciousness among consumers has generated interest in the use of functional ingredients, including dietary fiber (DF), in popular food products like baked foods. Kurek, M., & Wyrwisz, J. (2015). Consumers' demand has grown to a level where they seek out healthy and pleasant organoleptic foods, as well as functional foods. Karelakis, C., et al. (2020).

1.2 Nutritional and functional benefits

The banana *pseudo-stem* is a robust structure that rises from the soil and serves as the main support for the herbaceous plant. The consumable section of banana stem is the inner part of the fibrous stalk known as the banana center core. Munishamanna, K. B. et al. (2020). Indias annual banana production stands at 26.2 million tons. The banana *pseudo-stem* is rich in vitamins, minerals and dietary fiber. It also includes vital nutrients like magnesium, calcium and potassium that support general health. Thorat, R. L., & Bobade, H. P (2018). The pseudo-stem makes up 75% of the waste, while the remaining portion constitutes 25%. The aim of this paper is to highlight the significance of bioactive compounds present in banana *pseudo-stems,*

suggesting that they can be regarded as sustainable food sources and their use as culinary ingredients and in various other industries. Although bulk waste is biodegradable, it creates numerous environmental issues. Therefore, sustainable waste management and effective use of the residue can help in utilizing the bioactive and nutrient compounds while also addressing the economic and ecological challenges related to the problem. Pillai, G. S., et al. (2024). Several research have indicated that banana *pseudo- stem* powder is recognized as treatment for urinary issues and digestive problems such as flatulence, diarrhea, and dysentery. It also aids in detoxifying the body as well as lowering obesity. Thorat, R. L.,& Bobade, H. P (2018).

Pseudo-stems are abundant in dietary fiber and provide numerous health benefits. Dietary fiber was assessed utilizing three techniques, especially the recognized AOAC method, Gas chromatography, and nuclear magnetic resonance. Ma, J. (2015). People who consume high levels of dietary fiber appear to have a significantly lower risk of developing coronary heart disease, hypertension, diabetes, stroke, obesity and certain gastrointestinal disorders. Increasing fiber intake helps reduce blood pressure and serum cholesterol levels. Greater fiber consumption benefits various gastrointestinal issues, including constipation, hemorrhoids, duodenal ulcers, and gastroesophageal reflux disease. Fiber supplementation in overweight individuals considerably improves weight reduction. The recommended intake of dietary fiber for children and adults is 14 grams for every 1000 kcal. Anderson, J.W., et al. (2009).

1.1 Proximate composition of banana *pseudo-stem*

Nutrients	**Content (%)**
Protein	2.5
Fat	1.7
Free sugar	3.4
Soluble dietary fiber	1.4
Insoluble dietary fiber	27.4
Starch	27.3
Ash	0.3
Moisture	15.1

1.3 Drying method

Considering the short shelf-life of fresh banana *pseudo-stems*, a study was performed on the drying process using a cabinet dryer under various conditions, including temperatures of 40ºC and 50ºC, with and without blanching. This analysis focused on drying time, color properties and quality of the dehydrated product regarding nutrient preservation. The approach of drying at 50ºC without blanching yielded the most luminous color and the most expedient drying time. Consequently, the ideal drying condition was determined to be 50ºCMwithout blanching, based on preservation of nutrients. In this research banana *pseudo-stems* from *Musa balbisiana* and *Musa acuminata* were utilized. No notable variation was observed in the protein, fat, and

carbohydrate, composition of bananas *pseudo-stems* subjected to different drying conditions. Ma, J. (2015).

1.2 CLASSIFICATION OF BANANA

Kingdom	Plantae
Subkingdom	Tracheobionta
Subdivision	Spermatophyta
Division	Magnoliophyta
Class	Liliopsida
Subclass	Commelinidae
Order	Zingiberales
Family	Musaceae
Genus	Musa
Species	Musa paradisiaca

1.4 DIFFERENT VARIETIES OF BANANA

1.4.1 Dwarf Cavendish (AAA)

It is a well-known commercial type grown extensively in Maharashtra, Bihar, West Bengal, and Gujarat. The plant's height is low, making it less valuable to wind damage. It flourishes in light soil with high level of inputs.

1.4.2 Robusta (AAA)

It is a medium-height variety, primarily cultivated in Tamil Nadu and certain regions of Karnataka, Maharashtra and Andhra Pradesh. It is a high yielding variety that produces large bunches with well-formed fruits.

1.4.3 Poovan (Mysore AAB)

It is a popular plant grown across India, with special types for different areas. Palayankodan is in Kerala, Poovan is in Tamil Nadu, Karpura Chakkarakeli is in Andhra Pradesh, and Alpan is in the Northeast. It is usually grown as long-lasting crops.

1.4.4 Nendran (AAB)

It is a favored variety in Kerala, where it is enjoyed as a fruit and used for processing. The commercial farming of Nendran (Eatha) has increased quickly in Tamil Nadu recently.

1.4.5 Red Banana (AAA)

Red banana is the most enjoyed and highly valued type in Kerala and Tamil Nadu. It's commercial farming is significant in Kanyakumari and Tirunelveli districts of Tamil Nadu. It is also well-liked in Karnataka, Andhra Pradesh and to a certain extend in western and central India.

1.5 WHEAT

Wheat has been consumed for thousands of years and was one of the first cereal crops ro be grown. Wheat is an essential component of many diets since it accounts for 20% of the calories of daily intake. It supports 80 million farmers and makes a substantial contribution to food security, making it the second when it comes to the important crops in the developing nations after rice. Wheats widespread use is due to its adaptability with growing conditions around the world. And also, the ease of storing grains, the processing of flour for its culinary uses. Giraldo et al.,(2019).

Even though the intake of whole grains, such as bread made from whole wheat flour, is encouraged for its health advantages and lower risk of disease and morality, consumer approval and consumption of certain whole wheat items remain low in comparison to white breads. Gomez M et al., (2020). Glutenin polypeptides, the building blocks of gluten, significantly impact the quality of dough. Uthayakumaran & Wrigley (2017). The rheological characteristics of wheat influence the quality of the finished baked product as well as how wheat flour dough behaves when combined and kneaded. Understanding these features is essential as baking becomes more automated. To increase the shelflife and enhance the flavour of the dough, the ingredients such a yeast, sugar, water and additives are combined together during mixing process. Iqbal et al.,(2022).

Humidity has an impact on wheat's moisture content. Commercially distributed wheat is usually stored at 14% moisture content or lower to maintain quality. Physical isolation is essential because stored wheat can be harmed by pests such as insects, rodents, and microbes. Although elevators and silos are frequently utilized, airtight bunkers are also utilized for storage. Carbon dioxide or nitrogen flushes can be used to control pests and lower respiration in these bunkers. By lowering the moisture content, large fans aid in further stabilizing the wheat. Atwell & Finnie (2016).

1.3 Nutritional value of wheat

Nutrients (per 100 g)	Nutritional values
Energy	329 kcal
Protein	15 g
Total fat	1.3 g
Carbohydrates	68 g
Dietary fiber	12 g

1.6 Flaxseed

In the industry flaxseeds are being used in a variety of ways, since it has good health benefits. Flaxseed oil cake is a left over or byproduct from the clarification process of flaxseed oil. It is rich in bioactive compounds and it is extracted for food development in the industries as it is rich in polyphenols, flavonoids, lignans. Talwar et al. (2025). Flaxseed is a versatile crop with growing use in functional food development due to its high levels of omega-3 fatty acids and other beneficial plant compounds. Ganguly et al. (2021).

1.7 Sesame seed

Sesame seed has been grown globally and utilized for flavoring food, essential oil uses, and in traditional medicine for thousands of years. Mushtaq., et al. (2020). Sesame seed have been used and consumed for a long time to enhance salads, foods, sprinkle on dishes, in confectioneries, baking, for medicinal uses, and various other purposes. Saleem., et al. (2021).

CHAPTER II

REVIEW OF LITRATURE

Banana plants are large herbs that belong to the Musa genus within the Musaceae family. The banana *pseudo-stem* (BPS), which supports fruits, flowers, and leaves, can attain heights of 6-7.6 m. Pillai, et al.,(2024). The banana is an excellent and affordable food source for developing nations, where a large portion population depend primarily on banana for substance. Parts of banana plant serves various purposes, including insecticide, antioxidant, color absorber, and in the creation of different functional foods, wine, alcohol, biogas, and animal feed, among others. Mohapatra, et al.,(2010). Bananas are cultivated across the tropical and subtropical regions of the globe. They are essential for nutrition, health, and cultural practices of millions of individuals. Regarding global exports, banana is the fifth most significant crop following coffee, cereals, sugar, and cocoa. Banana produces a large amount of biomass after the fruit bunch is harvested, including *pseudo-stem* (30-34%), leaves flowers and bracts (5%), and rhizome (12-14%). Shift in consumer behaviour and food consumption trend have enhanced the opportunity to explore innovative and sustainable products within the field of food technology. Uma et al.,(2022). *Pseudo-stem* is not as popular as other leafy vegetables because of its discoloration and taste. After the harvest, banana *pseudo-stem* quickly browns, which makes it less appealing to consumers and lowers its market value. (Sreekumar & Padhan 2022). Beyond its use in medicine and in the culinary, recent research has found that plantains and their parts are rich in beneficial plant compounds. (Reddy & Hemachandran, 2014). There is increasing enthusiasm for incorporating banana *pseudo-stem* into functional food and nutraceutical offerings. The banana *pseudo-stem* (BPS) constitutes a vital element of the plants biomass, yet it is frequently discarded on the plantation or set on fire. BPS, has rich source in cellulose, total carbohydrates, and fiber. The *pseudo-stem* is the part of the plantain plant that forms when leaf stalks overlap tightly, creating a cylindrical shape with a tender core in the center. Plantain stems, an inexpensive agricultural byproduct, hold the potential to be processed into much more valuable products.

At present, banana *pseudo-stems* are frequently thrown away along roadsides or incinerated, which adds to environmental pollution. Making use of agricultural waste is in line with green technology principles, fostering sustainable development. Additionally, it provides extra income for both processing industries and small-scale farmers. (Padam et al., 2014). Some other applications of banana pseudo stems are: Organic farming, heavy metal and dye, fuel, organic manure, substrate for edible, and as natural fiber. The Food applications of banana pseudo-stem include the South Indian cuisine for its central core. Central core in the banana pseudo-stem is an edible part. In southern India, the pseudo-stem is cooked as both a stir-fry and a gravy, which is seasoned with grated coconut, chillies, shallots, Garlic, curry leaves and ginger. A dish named Kolposola is made in the state of Assam using the banana pseudo-stem. (Sreekumar & Padhan, 2022). Dried banana pseudo-stem powder can be used to fortify different bakery products like cookies, biscuits and bread also in dairy products such as cheese, Shrikhand, and paneer with minerals and carbohydrates. (Thorat & Bobade, 2018). It has a low glycemic index and is high in dietary fiber and antioxidants, which makes it good for people with diabetes. (Bhaskar et al., 2011).

In southern India, people drink fresh juice made from the banana pseudo-stem to help prevent kidney stones. (Dawn et al., 2016). It has also found that many other health benefits such as control in obesity, diuretic and helps with the detoxification process in the body. Hence, this has influenced scientists to isolate and extract the different bioactive compounds present in the banana pseudo stem as they have been found to have an ample of significant ways to develop applications in nutraceuticals. The banana pseudo-stem is abundant in nutrients which provides various health benefits. A product which is developed by banana pseudo-stem powder can be considered nutraceuticals as it has dietary and potential health benefits. This has led researchers to focus on isolating, identifying, and quantifying the various bioactive elements founding *pseudo-stem*, as they may have important functions in nutraceuticals. The comparative study of different parts of the plantain plant for their hypoglycemic effects revealed that banana stem juice extract exhibited the highest antidiabetic activity compared to the peels, fruit and rhizome. (Reddy & Hemachandran, 2014). The various bioactive components present in the pseudo-stem enhance the nutritional and therapeutic value of food products. In conclusion, Efficient utilization of banana pseudo-stem can address the current issue of agro-waste management, directly benefiting growers and significantly contributing to increasing the share of horticulture in India's overall agricultural GDP. (Sreekumar & Padhan, 2022).

2.1 PARTS OF BANANA PLANT

2.1.1 BANANA PSEUDO-STEM

The banana pseudo-stem is the byproduct from banana plant following the harvesting of the trees. It is employed to create paper, fabrics, ropes, crafts, and additional items. Banana pseudo-stem powder is incorporated into various food items like bakery goods such as bun, biscuits, bread, and cookies as well as diary products like cheese, Srikhand, and paneer, to enhance these products with fiber, total carbohydrates, and minerals. Throat & Bobade.,(2018). The present research is focused on (BPS), which is usually disposed of as water or combusted, as a source of antioxidants or polyphenols. (Saravanan & aradhya.,(2011). The pseudo-stem was divided into three parts: the outer pseudo-stem part (OPS), the inner pseudo-stem part (IPS), and the whole pseudo-stem (WPS). Ali, et al., (2021). The carbohydrate content of banana pseudo-stem features a low glycemic index, which allows it to serve as a flour substitute in functional foods. The juice from banana stem exhibits potential biological effects, such as anti-inflammatory, anti -diabetic, anti-helminthic, and anti-oxidant properties. Kendole et al, (2022). The banana pseudo-stem is utilized in different industries for culinary ingredients, fibers, and toxic substance removal. Additionally, when applied for heavy metal remediation in waste water, its fibers are robust enough to be used in production of cardboard and food packaging material. The banana pseudo-stem can be categorized into two parts: the central core which serve as a food raw material, and outer sheaths, which are utilized in various industries. In Japan, banana fiber has been utilized to produce currency note paper because it is the strongest natural fiber that can be obtained. The powdered pseudo-stem is used to boost the nutritional content of numerous recipes. Pillai, et al.,(2024).

2.1.2 BANANA FLOWER

The banana flower often called the banana male bud or banana blossom is an edible product of banana cultivation. Due to its considerable nutritional value, it is enjoyed in various Asian countries such as Sri Lanka, Malaysia, Indonesia, the Philippines and India. Farmers often throw away banana blossoms, leading to considerable waste after harvesting. Soni & Saxena., (2021). The use of banana flower as a vegetable is widely favored in numerous countries across southeast Asia. Marikkar, et al., (2016). The flower of banana is abundant in phytochemicals, including vitamins, flavonoids, and protein, and possesses antioxidant properties. Nadumane & Timsina., (2014). Flowers from all banana varieties including culinary types, are a by-product of postharvest cultivation and are a valuable source of dietary fiber. This nutritious flower is eaten as a vegetable, it is utilized to combat various disease due to its significant medicinal properties. (begum and deka, 2019). Based on literature studies, this review has identified the bioactive compounds present in banana blossom, including phenolics, flavonoids, dietary fibers, tannins, saponins and vitamins as well as the potential biological activities of this flower, such as antioxidant, anti-hyperglycemic, anti-inflammatory, and antimicrobial effects. Therefore, it can be concluded that banana blossoms hold suitable amounts of advantageous secondary metabolites that are important for promoting good health. suffi et.al,(2021).

2.1.3 BANANA FRUIT

Fruits and their various types play a crucial role in maintaining good health and may be able to cut the risk of chronic ailments including stroke, gastrointestinal disease, high blood pressure, specific cancers, age-related macular degeneration, heart disease, cataracts, elevated LDL cholesterol, and skin conditions. Additionally, they support the immune system. They also enhance immune function. They also support the immune system. Incorporating fruits into your diet is vital, and the USDA suggests aiming for five servings each day to enjoy their health advantage. Fruits classified according to their growing environments: tropical, temperate, and subtropical. Bananas are tropical fruits that thrive in rainforest conditions. They are yielded by herbaceous plants of the genus Musa and family Musaceae. The fruits can either be consumed raw or cooked and are referred to as plantains. Seedless edible bananas have two primary species, which include Musa balbisiana and Musa acuminata. Sidhu & Zafar (2018) Bananas are a nutritious, low-cost food for most developing nations, where they are a primary food for most of the population. Mohapatra et al., (2010).

2.1.4 BANANA LEAF

Banana leaves are a common option for the dining plate due to the fact that they are not just ecofriendly, but they are also healthy. (Kumari et.al,2023). Banana plant is a storehouse of uses, giving food to both humans and animals, and even providing medicinal use. Right from its flowers to its stem and even fruit juice, the whole plant has fruitful applications. The peels as well as banana leaves are found have to medicinal properties which prove useful in curing certain diseases such as burns, ulcers, diarrhoea, and dysentery. Banana leaves are also thought to have numerous medicinal advantages such as purification of the blood, chest pain relief, and ulcer prevention, leukaemia, and skin illnesses. Banana leaf juice is a traditional remedy for certain diseases such as respiratory disease, gastrointestinal disease, and even certain chronic disease. Daily intake of this juice may lead to total health and wellness. Rajesh. (2017).

2.2 ANTIMICROBIAL PROPERTIES OF BANANA PLANT PARTS

2.2.1 *Pseudo-stem*

The banana pseudo-stem has potential health benefits. Containing anti-inflammatory, anti-microbial, anti-cancer, anti-diabetic, anti-helminthic, and antioxidant qualities. Many phytochemical components in banana stem extracts mainly explain their antibacterial properties. The tannin content in the banana stem has conferred anti-hemorrhagic and anti-diarrheic properties. This has been used from olden days to treat diarrhea, and also wounds, insect bites and cuts. Flavonoids have antioxidant function and has shown prevention against tumor and its growth. These constituents have potential medicinal benefits. Kendole et al., (2022). There were no inhibition zones because, according to the study, none of the extracts had antifungal qualities. However, against particular bacterial strains like Streptococcus faecalis, Klebsiella sp., Escherichia coli and Pseudomonas aeruginosa, extracts from the *pseudo-stem* showed antibacterial activity. Kumar et al.,(2014).

It has been demonstrated that fungi are impacted by crude extracts of banana plants. For instance, the bacteria Escherichia coli and Candida albicans. Kanedi et al.,(2023).

2.2.2 Banana Peels

In the peels of the banana, the secondary metabolites called flavonoids, alkaloids, saponins and tannins found in banana peel extract are the source of the antioxidant activity. Ariani & Riski (2018). In the study it was found that green peels of the banana demonstrated higher levels of antioxidant properties compared to yellow peels. Hikal et al., (2021). The extract from banana peels may be a natural antimicrobial that helps stop dangerous microorganisms from growing in food, enhancing food safety and providing other health advantages. Shaukat et al.,(2023).

2.2.3 Banana Blossom (Banana Flower)

Banana blossoms contain several medicinal benefits which makes it a functional food. Along with a multitude of nutrients, such as protein, calcium, copper, iron, potassium, and vitamins A, C, and E, this functional food has several antioxidant properties. Singh (2017). The antimicrobial activity of banana blossoms is known to inhibit the growth of numerous bacterial strains, both Gram-positive and Gram-negative. Sartika et al. (2019). It also contains a good number of phytochemical compounds which can be classified as highly nutritional.

2.2.4 Banana Leaves

Rich in antioxidants, banana leaves enable fight oxidative stress. This is crucial since different skin issues and aging of skin depend mostly on oxidative stress. By protecting skin cells from free radical damage, these antioxidants aid in the maintenance of healthy skin. Swelling is reduced by the anti-inflammatory qualities of banana leaves. Additionally antimicrobial properties in banana leaves can help ward against skin condition-related wounds and infections. Gupta & Naragatti (2023).

2.2.5 Banana Fruit

Bananas' great nutritional value drives consumption of them worldwide. Bananas are abounded in polyunsaturated fatty acids, vitamins A, B1, B2, C, minerals like potassium, and sugar derivatives. Additionally good sources of acids like oxalic and malic acid and bioactive compounds like glycosides are there. Negi & Mathew, (2017). Apart from other kinds of fiber, such non-starch polysaccharides, green bananas and their flour are a good source of resistant starch, a kind of fiber that is challenging for digestion. Garcia Valle et al.,(2019).

2.3 WHEAT

Wheat is a global staple, used to create a wide variety of products. Today there are 3 species of common varieties of wheat which are used worldwide. T. aestivum, T. compactum and T. durum. The suitability of wheat types varies depending on the intended product.

In the production of Breads and other yeast-leavened, dough-based products typically utilize HRW (Hard red winter), HW (Hard wheat), and HRS (Hard red spring) wheat varieties. SRW (Soft red wheat) and SW (Soft wheat), wheat varieties are frequently used in the production of batter-based products, breakfast cereals, cakes, crackers and cookies. To produce Pasta products like spaghetti and macaroni, are typically made with durum wheat.

Wheat Flours are milled to varieties.

Whole wheat flour

Whole-wheat flour is made when the entire wheat kernel is ground, separated, and then recombined. There are two types of milling processes done for wheat. One way is by grinding the grains, another one is to mix up flour from different streams of white flour milling. Unlike traditional milling, integrated milling doesn't typically temper the wheat before grinding. This lack of tempering results in smaller bran particles compared to tempered wheat.

White flour

The least amount of bran is present in these flours, with an extraction rate of 72%. The majority of the bran and germ is removed in this flour which is also named as straight-grade flour. Finnie & Atwell (2016).
The elasticity and air-holding capacity of the dough, which are essential for fermentation and the finished quality of baked goods, are significantly influenced by the gluten network. This includes nutritional components that are affected by the texture of the dough while it is being mixed, such as the glycaemic index and fiber content.Valle et al.,(2022). According to a study, the protein content of wheat varies greatly, for hard wheats ranging from 6.2% to 19.8%, typically having higher protein levels. The protein content ranged from a minimum of slightly over 6.1% to a maximum of 19.8%. It's interesting to note that 42% of the examined wheat kernels had protein contents in the medium-to-low protein range of 8% to 10%. Caporaso et al.,(2018).

2.4 Flaxseed (Linum usitatissimum)

Flax seed is commonly referred as Alsi, Jawas, Aksebija, and other names in Indian languages, is a blue-flowering plant that yields small, flat seeds that vary in color from golden yellow to reddish brown. Gutte et al., (2015). Flaxseed is an important provider of high-quality protein and soluble fiber, and it offers considerable potential as a source of phenolic compounds. Oomah Dave B., (2001). Flaxseed carries substantial amount of dietary fiber, omega-3 fatty acid, lignan secoisolariciresinol diglucoside and alpha-linolenic acid. These components confer bioactive benefits that enhance health in both humans and animals, attributable to their anti-inflammatory properties, antioxidant functions, and influence on lipid profiles. Parikh, et al., (2019). Today in the food sector functional foods has an increased demand, because of high nutritional benefits it contributes. This component is naturally found in compounds such as Omega-3 which is beneficial for cardiovascular health, and also lignans recognized for the effects in anti-cancer and antioxidant properties Rabetafika, et al, (2011). Flaxseed is rich in dietary fiber which helps with bowel movements, constipation and also acts in the regulation of cholesterol levels. Gutte and Ranveer., (2015).

2.5 Sesame (Sesamum indicum L.)

Sesame seeds have been cultivated for centuries and are best known for their culinary application. Not only are sesame seeds wonderful with a nutty flavour and crunchy texture, but they are famous for possessing amazing health qualities The extreme content of polyunsaturated fatty acids in sesame seeds is responsible for their total contribution to less risk of chronic disease. Mostashari & Khaneghah (2024). Sesame seeds, which are rich in protein, are among the oldest crops being processed for oil. They have more than a single application beyond food, used in soap, cosmetics, lubricants, and drugs. Sesame seeds possess two special compounds, sesamin and sesamolin, that reduce cholesterol and guard against high blood pressure in human beings. Refined sesame oil comprises precious antioxidant compounds such as lignans, which are the basis of food shelf life and augment flavour and flavour. Anilakumar et al,.(2010)..Sesame seeds are applied in cooking purposes like decorating bread and cookies, making paste for some food dishes, and desserts. (Elleuch et al. 2011). Sesame seeds also play a role in human health by supplying vital nutrients such as protein, unsaturated fatty acids, vitamins, and minerals. (Hafiza Madiha Jaffar, et al. 2025).

CHAPTER III

MATERIALS AND METHODOLOGY

3.1 SELECTION OF RAW MATERIAL

The raw material selected for the preparation of burger bun are banana pith (pseudo-stem) powder, wheat flour, yeast, butter, brown sugar, salt, milk, water, flaxseed, and sesame seed. All the materials are selected and procured from a local market.

3.2 METHOD OF PREPARATION

The banana pseudo-stem was first cleaned and washed thoroughly, then cut into very small pieces and placed in a tray drier, where it was dried at 30°C-60°C for four days. The obtained dried mass was then ground into fine powder using a grinder. The banana pseudo-stem powder was then combined with wheat flour and salt. The yeast was measured using a weighing scale, and brown sugar and yeast were added into warm water, then allowed to rest for 10-15 minutes to activate the yeast. The yeast mixture was then added into the dry powders, along with some warm milk, and the mixture was combined. The dough was kneaded thoroughly until the gluten formed, after which butter was measured using a weighing scale and added into the dough. The dough was allowed to rest for 1 to 1½ hours to rise. After rising, flax seeds were added, and the dough was kneaded again before being shaped into buns. The buns were allowed to proof for 30-40 minutes. The oven was preheated to 170°C for 15 minutes. The buns were then washed with milk, sprinkled with flaxseed on top, and baked at 170°C for 20 minutes.

The banana pseudo-stem was first cleaned and washed thoroughly, then cut into very small pieces and placed in a tray drier, where it was dried at 30°C-60°C for four days. The obtained dried mass was then ground into fine powder using a grinder. The banana pseudo-stem powder was then combined with wheat flour and salt. The yeast was measured using a weighing scale, and brown sugar and yeast were added into warm water, then allowed to rest for 10-15 minutes to activate the yeast. The yeast mixture was then added into the dry powders, along with some warm milk, and the mixture was combined. The dough was kneaded thoroughly until the gluten formed, after which butter was measured using a weighing scale and added into the dough. The dough was allowed to rest for 1 to 1½ hours to rise.

After rising, flax seeds were added, and the dough was kneaded again before being shaped into buns. The buns were allowed to proof for 30-40 minutes. The oven was preheated to 170°C for 15 minutes. The buns were then washed with milk, sprinkled with flaxseed on top, and baked at 170°C for 20 minutes.

DRYING PROCESS

Fig 3.1 Weight of dried banana pith

Fig 3.2 Dried banana pith

Fig 3.3 Ground banana pith weight

EQUIPMENT USED

Fig 3.4 Oven

Fig 3.5 Tray Dryer

Fig 3.6 Grinder

INGREDIENTS

Fig 3.7 Yeast

Fig 3.8 Brown sugar

Fig 3.9 Butter

Fig 3.10 Whole wheat flour

Fig 3.11 Banana Pith powder

Fig 3.12 Sesame seeds

Fig 3.13 Flaxseeds

3.3 PREPARTION OF BURGER BUN

3.3.1 Experimental design

1. P1- Banana pith powder (20g) + wheat flour (180g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + flaxseed (8g)
2. P2- Banana pith powder (20g) + wheat flour (180g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + sesame seed (3g)
3. P3- Banana pith powder (40g) + wheat flour (160g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + flaxseed (8g)
4. P4- Banana pith powder (40g) + wheat flour (160g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + sesame seed (3g)

Product Formulation

Sample	Banana Pith powder	Wheat Flour	Yeast	Butter	Brown Sugar	Salt	Water	Milk	Flaxseed	Sesame Seed
1	20 g	180 g	5 g	20 g	60 g	6 g	100 ml	150 ml	8 g	-
2	20g	180 g	5 g	20 g	60 g	6 g	100 ml	150 ml	-	3 g
3	40 g	160 g	5 g	20 g	60 g	6 g	100 ml	150 ml	8 g	-
4	40 g	160 g	5 g	20 g	60 g	6 g	100 ml	150 ml	-	3 g

Table 3.1 Product Formulation

Burger Buns

Fig 3.14 Dough rise

Fig 3.15 Buns before baking

Fig 3.16 Banana Pith Burger

Method of preparation for sample 1 & 3

The banana pseudo-stem is thoroughly washed to remove any dirt, debris, or contaminants, ensuring that the final product is safe and hygienic for consumption

After washing, the banana pseudo-stem is cut into very small pieces.

The small pieces of the banana pseudo-stem are placed in a tray drier and dried at a temperature between 30°C to 60°C for about 4 days.

Once the pieces are thoroughly dried, they are ground into a fine powder using a grinder.

The banana pseudo-stem powder is mixed with wheat flour and salt. This combination of dry ingredients will form the base for the dough.

Yeast is mixed with brown sugar and warm water, then left to rest for 10-15 minutes. This step activates the yeast, enabling it to begin fermentation.

The activated yeast mixture is then added to the dry ingredients, along with warm milk. The ingredients are combined to form a dough-like consistency.

The dough is kneaded thoroughly to develop gluten, which gives the dough elasticity.

Butter is measured and added to the dough. It enriches the dough, making it softer and enhancing the flavour of the final product.

The dough is left to rest for 1 to 1½ hours. During this time, the yeast ferments the dough, causing it to rise and become light and airy.

After the dough has risen, flaxseed is added to the mixture. The dough is kneaded again to ensure the flaxseed is evenly distributed.

The dough is then shaped into individual bun forms. This step involves dividing the dough into portions and rolling or forming them into the desired shape.

The shaped buns are allowed to proof for 30-40 minutes.

While the buns are proofing, the oven is preheated to 170°C for 15 minutes.

Before baking, the buns are brushed with a milk wash to give them a golden colour and sprinkled with flaxseed on top.

The buns are then baked in the preheated oven at 170°C for 20 minutes.

Flow chart 3.1 Process Flow Chart

Method and preparation of sample 2 & 4

The banana pseudo-stem is thoroughly washed to remove any dirt, debris, or contaminants, ensuring that the final product is safe and hygienic for consumption

After washing, the banana pseudo-stem is cut into very small pieces.

The small pieces of the banana pseudo-stem are placed in a tray drier and dried at a temperature between 30°C to 60°C for about 4 days.

Once the pieces are thoroughly dried, they are ground into a fine powder using a grinder.

The banana pseudo-stem powder is mixed with wheat flour and salt. This combination of dry ingredients will form the base for the dough.

Yeast is mixed with brown sugar and warm water, then left to rest for 10-15 minutes. This step activates the yeast, enabling it to begin fermentation.

The activated yeast mixture is then added to the dry ingredients, along with warm milk. The ingredients are combined to form a dough-like consistency.

The dough is kneaded thoroughly to develop gluten, which gives the dough elasticity.

Butter is measured and added to the dough. It enriches the dough, making it softer and enhancing the flavour of the final product.

The dough is left to rest for 1 to 1½ hours. During this time, the yeast ferments the dough, causing it to rise and become light and airy.

After the dough has risen, the dough is kneaded again

The dough is then shaped into individual bun forms. This step involves dividing the dough into portions and rolling or forming them into the desired shape.

The shaped buns are allowed to proof for 30-40 minutes.

While the buns are proofing, the oven is preheated to 170°C for 15 minutes.

Before baking, the buns are brushed with a milk wash to give them a golden colour and sprinkled with sesame seed on top.

The buns are then baked in the preheated oven at 170°C for 20 minutes.

Flow chart 3.2 Process Flow Chart

3.4 PROXIMATE ANALYSIS

3.4.1 Determination of the moisture content

TEST METHOD: IS:12711:1989;R-2015

SCOPE: To determine the moisture content.

APPARATUS:

- Dish made of porcelain, silica or platinum
- Electric oven
- Weighing balance
- Desiccator

PROCEDURE:

- 5g of sample is accurately weighed in a previously dried and weighed moisture dish
- It is then dried in an oven at 105±2˚C, for 4hours.
- The moisture dish is cooled in a desiccator and is weighed with the lid on.
- The process of drying, cooling and weighing is repeated at half-hour intervals until the loss in weight between two successive weighing is less than one milligram.
- The lowest mass obtained is recorded.

CALCULATION

Moisture, percentage by mass = $\frac{100\ (M_1-M_2)}{M_1-M}$

Where, M_1 = mass, in g of dish with material before drying

M_2 = mass in g of dish with material after drying to constant mass, and

M = mass in g of the empty dish

3.4.2 Determination of Protein

TEST METHOD: AOAC 20th Edn 2016.920.152

SCOPE: To determine the total Protein.

PRINCIPLE: Test portion is digested in H_2SO_4, using HgO as catalyst, converting nitrogen to NH3 which is distilled and titrated.

REAGENTS:

- Sodium hydroxide solution: 450g in one-liter distilled water
- Boiling stones
- Standard Sulphuric acid solution: 0.25M
- Standard Sodium hydroxide Solution: 0.5M
- Methyl Red indicator: 1g in 100ml methanol

PROCEDURE:

- A sample weighing between 0.70 to 2.20g is accurately weighed and placed into the digestion flask.
- 0.7g of HgO and 15g of Na2SO4 are added to the flask.
- 25ml of Sulphuric acid is added to the mixture.
- The flask is placed in an inclined position on a heater and is gently heated until frothing ceases.
- The solution is boiled until it becomes clear.
- The solution is cooled, and approximately 200ml of distilled water is added, then cooled to room temperature.
- 25ml of Thiosulphate solution (8% in water) is added and mixed to precipitate mercury.
- Sodium hydroxide solution is carefully added along the sides of the flask to make the solution strongly alkaline.
- The apparatus is assembled, ensuring that the tip of the condenser extends below the surface of a known quantity of standard sulphuric acid with 5-7 drops of methyl red indicator added.
- The mixture is immediately heated until all ammonia has distilled (150ml).
- The receiver is lowered before stopping distillation, and the tip of the condenser is washed with distilled water.
- The solution is titrated against standard sodium hydroxide solution.
- A blank determination on reagents is corrected.

CALCULATION

$$\text{Nitrogen content (N) in \%} = \frac{[(M_{acid})\,(ml_{acid}) - (ml_{NaOH})\,(M_{NaOH})] \times 1400.67}{\text{mg test portion weight}}$$

Where,

M_{acid} = molarity of standard acid,

ml_{acid} = volume in ml of acid used as trapping solution

M_{NaOH} = molarity of standard base

ml_{NaOH} =volume in ml of standard base used for titrating

3.4.3 Determination of fat content

TEST METHOD: IS:12711:1989;R-2015

SCOPE: Method of determination of Fat content.

APPARATUS:

- Soxhlet Extraction Apparatus
- Electric oven
- Weighing balance

PROCEDURE:

- Approximately 5g of the material was accurately weighed and dried for 2 hours at 100±2˚C.
- The thimble containing the material was placed in the Soxhlet extraction apparatus, and extraction with Petroleum Ether (40-60˚C) was carried out for 8 hours.
- After extraction, the extract contained in the Soxhlet flask was dried. The empty mass of the Soxhlet flask had been previously determined by taring at 95˚C -100˚C for one hour.
- The dried extract was then cooled in a desiccator and weighed.
- The process of drying, cooling, and weighing was repeated at half-hour intervals until the difference in mass between two consecutive weighing was less than two milligrams.
- The lowest mass obtained was recorded.

CALCULATION

Fat, percent by mass = $100 \frac{(M_1-M_2)}{M}$

Where, M_1 = mass, in g of Soxhlet flask with the extracted fat

M_2 = mass in g of empty Soxhlet flask, and

M = mass in g of the material taken for rest

3.4.4 Determination of total ash content

TEST METHOD: IS:12711:1989;R-2015
SCOPE: To determine the Total ash content.

APPARATUS:

- Crucible made of porcelain
- Furnace
- Weighing balance
- Desiccator

PROCEDURE:

- An accurately weighed sample of approximately 5 grams of the powdered material is placed into a crucible.
- The sample is then ignited in the crucible using the flame of a suitable burner for around one hour.
- Following this, the crucible containing the sample is transferred into a muffle furnace, where it is subjected to a temperature of 500 ±10˚C until grey ash forms.
- The crucible is subsequently cooled in a desiccator and weighed.
- This process of igniting, cooling, and weighing is repeated at half-hour intervals until the difference in mass between two successive weighing is less than one milligram.
- The lowest mass obtained is then recorded.

CALCULATION

$$\text{Total ash (on dry basis), percent by mass} = \frac{100(M_2-M) \times 100}{M_2-M \times (100-W)}$$

Where, M_1 = mass, in g of dish with the material taken for test

M_2 = mass in g of dish with ash

M = mass in g of the empty dish

W = moisture % of the sample

3.4.5 Determination of Carbohydrate

TEST METHOD: AOAC 20th Edn 2016 986.25
SCOPE: To determine the carbohydrates content (by difference method).

PROCEDURE:

The total carbohydrates are calculated after the percentage of moisture, total protein, fat, and total ash have been determined.

CALCULATION

Total carbohydrates = 100 - (A+B+C+D)

Where A = percent by mass of moisture
B = percent by mass of total protein
C = percent by mass of fat and
D = percent by mass of total ash

3.4.6 Determination of energy

TEST METHOD: Pearson's composition & analysis of food
SCOPE: Method of determination of energy value in Food grains

Energy in Kcal= (Carbohydrate x 4) + (Total fat x 9) + (protein x 4)

3.4.7 Determination of Crude fiber

TEST METHOD : IS:1797;13 1985 R-2017
SCOPE :To determine the crude fiber content

PRINCIPLE
Crude fiber is the organic matter in the dried residue and is determined after digesting the sample with dilute sulphuric acid and sodium hydroxide. This method is applicable to all food products having crude fiber content.

REAGENTS

- Sulphuric acid solution 0.255 N, (12.5 g of sulphuric acid Sp.Gr. 1.84, dilute to 1 litre)
- Sodium hydroxide solution, 0.312 N (12.5 gm carbonate free NaOH per litre)
- Asbestos – Gooch grade,
- Ethyl alcohol, 95 %
- Methylene Chloride, anhydrous
- Sample preparation: Sample is prepared as per ASTA method No.I

PROCEDURE

2 gm of sample is extracted and taken in a thimble with methylene chloride to get the residue fat free. The residue is then transferred to a digestion flask.

200 ml of the sulphuric acid solution is added, with the digestion flask connected to the condenser and placed on a preheated hot plate, adjusting so that the acid will boil in about 5

minutes. Boiling is continued briskly for exactly 28 minutes with frequent rotation of the flask to ensure thorough wetting and mixing of the sample. The material should not be allowed to remain on the sides of the flask out of contact with the solution. Successive sample digestions should be started at approximately 3-minute intervals to facilitate accurate timing. After boiling for 28 minutes, the flask is removed, and the contents are immediately filtered through a filter cloth in a funnel. Washing is performed with boiling water until the washings are no longer acidic.

The sample is then quantitatively transferred to the digestion flask, with the filter cloth being washed with 200 ml of the NaOH solution. The flask is connected to the reflux condenser, placed on the preheated hot plate, brought to a boil in about 5 minutes, and boiled for exactly 28 minutes. Successive sample digestions should be started at approximately 3-minute intervals to facilitate accurate timing. After 28 minutes, the flask is removed, and the contents are immediately filtered through a Gooch crucible. The residue is washed thoroughly with

water and approximately 15 ml of ethyl alcohol. The crucible and its contents are dried at 110 (+/-) 2 C to a constant weight (approximately one hour). The crucible is cooled in a desiccator and weighed. The crucible and contents are then ignited in an electric muffle furnace at approximately 600°C for 20 minutes. The crucible is cooled in a desiccator and weighed again, determining the loss in weight on ignition.

CALCULATION

$$\text{Crude fiber \%} = \frac{\text{Loss in weight on ignition (gm)} \times 100}{\text{Weight of original sample (gm)}}$$

3.5 SENSORY EVALUATION

Sensory evaluation of burger bun incorporated with banana pith powder were carried out by panel members. The sensory panel members ere semi-trained panelists. The evaluation was done for assessing various quality attributes such as appearance and colour, taste, texture, and overall acceptability. A separate score of 9 point was given to each attribute.

The 9-point Hedonic Rating is given below:

9- Like Extremely

8- Like very Much

7- Like Moderate

6- Like slightly

5- Neither like nor Dislike

4- Dislike Slightly

3- Dislike Moderately

2- Dislike Very much

1- Dislike Extremely

CHAPTER IV

RESULTS AND DISCUSSIONS

4.1 SENSORY EVALUATION

Present investigation was undertaken to standardise the production of the development of Banana Pith Burger Buns. Studies and findings of the development of Banana Pith Burger Buns was done for the following composition; sample 1 with composition : (Banana pith powder + wheat flour + yeast + butter + brown sugar + salt + water + milk + flaxseed) in the ratio 4 : 20 : 180 : 5 : 20 : 60 : 6 : 100 : 150 : 8, sample 2 with the composition: (Banana pith powder + wheat flour + yeast + butter + brown sugar + salt + water + milk + sesame seed) in the ratio 7 : 60 : 2 : 7 : 20 : 2 : 33 : 50 : 1, Sample 3 with the composition: (Banana pith powder + wheat flour + yeast + butter + brown sugar + salt + water + milk + flaxseed) in the ratio 40 : 160 : 5 : 20 : 60 : 6 : 100 : 150 : 8, and sample 4 with the composition: - (Banana pith powder + wheat flour + yeast + butter + brown sugar + salt + water + milk + sesame seed) in the ratio 40 : 160 : 5 : 20 : 60 : 6 : 100 : 150 : 3. Based on 9-point hedonic scale as given in the table;

Table 4.1. Sensory Analysis

Characteristics and Attributes	Sample 1 (P1)	Sample 2 (P2)	Sample 3 (P3)	Sample 4 (P4)
Appearance	9	8	6	7
Aroma	7	6	5	5
Taste	9	8	7	7
Texture	9	9	7	8
Overall Acceptability	9	8	7	6

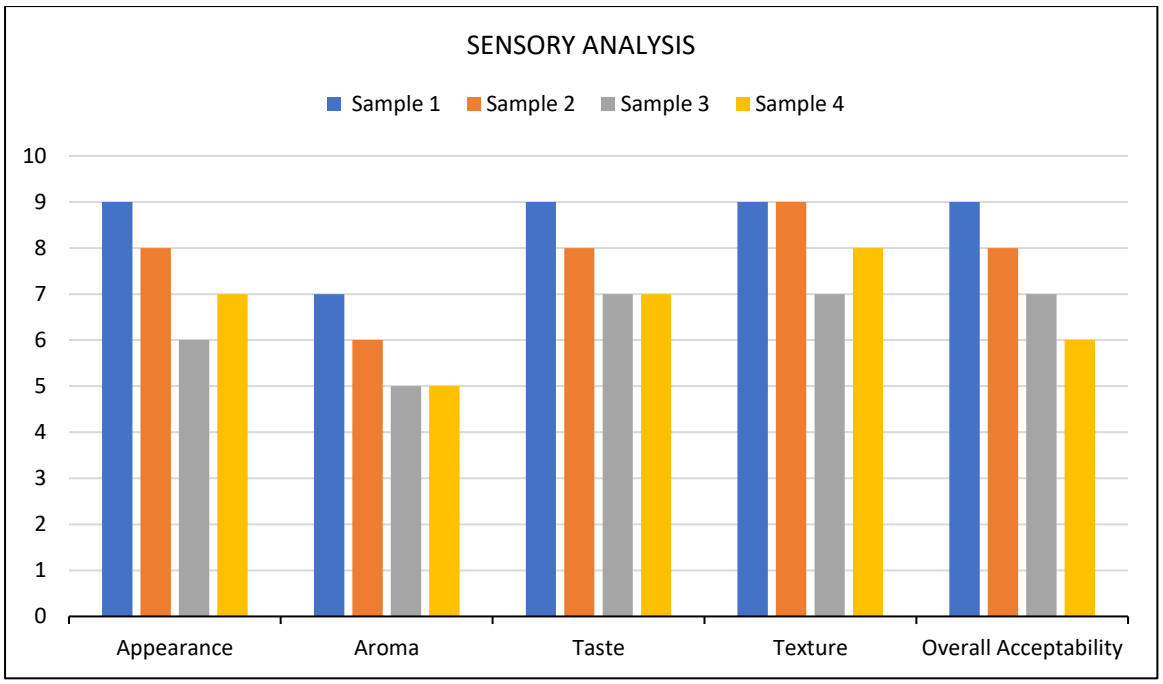

Fig 4.1 Sensory Analysis

4.1.1 Appearance

It was found that, the mean value of appearance of sample 1 with composition : (Banana pith powder + wheat flour + yeast + butter + brown sugar + salt + water + milk + flaxseed) in the ratio 4 : 20 : 180 : 5 : 20 : 60 : 6 : 100 : 150 : 8, sample 2 with the composition: (Banana pith powder + wheat flour + yeast + butter + brown sugar + salt + water + milk + sesame seed) in the ratio 7 : 60 : 2 : 7 : 20 : 2 : 33 : 50 : 1, Sample 3 with the composition: (Banana pith powder + wheat flour + yeast + butter + brown sugar + salt + water + milk + flaxseed) in the ratio 40 : 160 : 5 : 20 : 60 : 6 : 100 : 150 : 8, and sample 4 with the composition: - (Banana pith powder + wheat flour + yeast + butter + brown sugar + salt + water + milk + sesame seed) in the ratio 40 : 160 : 5 : 20 : 60 : 6 : 100 : 150 : 3 was found to be 9, 8, 6, 7 respectively from hedonic scale, sample 1 with the mean value of 9 was found to be better than the other samples.

4.1.2 Aroma

It was found that, the mean values for sample 1, sample 2, sample 3 and sample 4 was found to be 7, 6, 5, 5 respectively from hedonic scale, sample 1 with mean value 7 was found to be better than the other samples.

4.1.3 Taste

It was found that, the mean values for sample 1, sample 2, sample 3, and sample 4 was found to be 9, 8, 7, 7 respectively from hedonic scale, sample 1 with mean value 9 was found to be better than the other samples.

4.1.4 Texture

It was found that, the mean values for sample 1, sample 2, sample 3, and sample 4 was found to be 9, 9, 7, 8 respectively from the hedonic scale, sample 1 with mean value of 9 was found to be better than the other samples.

4.1.5 Overall acceptability

It was found that, the mean values for sample 1, sample 2, sample 3 and sample 4 was found to be 9, 8,7, 6 respectively from the hedonic scale, sample 1 with mean value of 9 was found to be better than other samples.

As it is observed from the table (Table 4.1), sample 1 and sample 2 have a higher sensory score than that of sample 3 and sample 4.

4.2 PROXIMATE EVALUATION

Chemical analysis (energy, total fat, carbohydrate content, crude fibre, protein content, total ash, moisture content) was done for the nutritional comparison of accepted banana pith buns sample 1. The proximate of the accepted sample are given below in the table.

SI.NO	Quality Parameters	Unit	Sample 1
1.	Moisture content	%	31.91
2.	Protein content	%	7.22
3.	Fat content	%	4.24
4.	Total Ash	%	2.66
5.	Carbohydrate	%	53.97
6.	Energy	Kcal	280
7.	Crude Fiber	%	1.48

Table 4.2 Proximate Analysis

4.2.1 Moisture Content

The moisture content in the sample 1 was recorded to be 31.91 %.

4.2.2 Protein Content

The protein content in the sample 1 was recorded to be 7.22 %.

4.2.3 Fat Content

The fat content in the sample 1 was recorded to be 4.24 %.

4.2.4 Total Ash

The total ash content in the sample 1 was recorded to be 2.66 %.

4.2.5 Carbohydrate

The carbohydrate content in the sample 1 was recorded to be 53.97 %.

4.2.6 Energy

The energy content in the sample 1 was recorded to be 280 Kcal.

4.2.7 Crude Fiber

The crude Fiber in the sample 1 was recorded to be 1.48 %.

CHAPTER V
SUMMARY AND CONCLUSION

The study concluded that the developed protein rich burger bun incorporated with banana pith powder and flaxseed had great nutritional content. The burger buns were rich in protein. Sample of the composition Banana pith powder (20g) + wheat flour (180g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + flaxseed (8g) was the most highly acceptable. Sample 1 with the composition: Banana pith powder (20g) + wheat flour (180g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + flaxseed (8g), Sample 2 with the composition: Banana pith powder (20g) + wheat flour (180g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + sesame seed (3g), Sample 3 with the composition: Banana pith powder (40g) + wheat flour (160g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + flaxseed (8g), and sample 4 with the composition: - Banana pith powder (40g) + wheat flour (160g) + yeast (5g) + butter (20g) + brown sugar (60g) + salt (6g) + water (100ml) + milk (150 ml) + sesame seed (3g) were analysed for their sensory and nutritional acceptability. It was observed that sample 1 was the most acceptable and sample 2, sample 3 and sample 4 were rejected. Sample 1 were analysed for moisture content, ash content, energy, carbohydrate, protein, crude fibre and fat.

CHAPTER VI

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APPENDIX 1

SENSORY EVALUATION SCORE CARD

NAME: Elizabeth Zarina Jacob DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Anna Aleena Paul DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Devalakshmi DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Nimisha DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Ardra DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Vismaya DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Aishwarya DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Rajalakshmi DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Blessy Mary DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										

SENSORY EVALUATION SCORE CARD

NAME: Althea Eliz DATE: 13-2-25

You are expected to judge the given product on a 9-point scale. Make a mark against your choice.

	Characteristics	Appearance		Aroma		Texture		Taste		Overall Acceptability	
	Sample	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
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										