SYNERGISTIC EFFECTS OF AMARANTH SEED FLOUR, GINGER, FENUGREEK, AND COCOA POWDER IN THE FUNCTIONAL NUTRI-MIX FOR ALLEVIATING DYSMENORRHOEA

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DECLARATION

We, Aryaganga Sunil Kumar (VB22FPT004), Devika Biju (VB22FPT009), and Sisna N T (VB22FPT020), hereby declare that the project titled **"Synergistic Effects of Amaranth Seed Flour, Ginger, Fenugreek, and Cocoa Powder in a Functional Nutri-mix for Alleviating Dysmenorrhoea"** is a Bonafide record of the project work done by us during study and that the report has not previously formed on the basis for the award to us for any degree, diploma, fellowship or other title of any other university or society.

Date:

Place:

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Devika Biju

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CERTIFICATE

This is to certify that the project entitled "**Synergistic Effects of Amaranth Seed Flour, Ginger, Fenugreek, and Cocoa Powder in a Functional Nutri-mix for Alleviating Dysmenorrhoea"** submitted in partial fulfillment of the requirement for the award of the degree of B. Voc Food Processing Technology to St. Teresa's college Ernakulam is a record of Bonafide research work carried by Aryaganga Sunil Kumar, Devika Biju, and Sisna N T 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 title or prize and that the work has not been published in part in any scientific or popular journal or magazine.

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ABSTRACT

Dysmenorrhea refers to painful menstrual periods, often characterized by severe cramps in the lower abdomen. It can significantly impact daily activities for many women, with symptoms ranging from mild discomfort to intense pain. Nutri mix powders can be beneficial for managing dysmenorrhea, particularly those enriched with specific herbs and nutrients. Ingredients like Amaranth seed powder, chia seed powder, ginger, fenugreek, and jaggery are known for their potential to alleviate menstrual cramps and discomfort. Amaranth seed powder may offer relief for dysmenorrhea due to its anti-inflammatory properties and nutritional benefits. Incorporating it into your diet, along with other whole grains, can help alleviate menstrual symptoms and promote overall hormonal balance. The present study aimed at the "**Synergistic Effects of Amaranth Seed Flour, Ginger, Fenugreek and Cocoa Powder in a Functional Nutri-mix for Alleviating Dysmenorrhoea ".** In this experimental study, Amaranth seed powder is mixed in a proportional ratio with chia seed powder, fenugreek powder, jaggery powder, and ginger powder. The nutri mix powder is made by grinding all the ingredients in a mixer. The powder form-based mix is examined by sensory evaluation using descriptive testing of the product's colour, taste, aroma, and acceptability rating. Sensory evaluation tests were conducted to assess consumer acceptance, alongside nutritional analysis to highlight the bun's health benefits. A product's shelf life is greatly impacted by several variables, including water activity, pH, redox potential, oxygen, nutrients, natural microflora, preservatives, time, temperature, and relative humidity.

To guarantee consumer satisfaction and safety, producers must include this information on the product's label. Two samples were chosen from the five created samples based on sensory preferences. Each is labeled S1 and S2, with the manufacturing date and weekly assessment, and is stored at room temperature. One is packed in a glass jar, while the other is packed in a paper bag. The daily inspection shows that the sample's color and scent are becoming lighter than they were on the first day. No mold growth or other signs of spoiling had been observed over the two weeks of study.

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CHAPTER 1

INTRODUCTION

Dysmenorrhea, or menstrual pain of uterine origin, is a frequent cause of pelvic pain and menstruation abnormalities that feature undesirable feelings, both physical and psychological, usually associated with tissue trauma or inflammation. Kumar, K. H., & Elavarasi, P. (2016). Definition of pain and classification of pain disorders. Journal of Advanced Clinical and Research Insights, 3(3), 87-90. It is a common occurrence in adolescents but often is not given attention despite its potential for feeling weak, lethargic, unable to focus, interfered with daily schedules, or even psychological issues. An inadequate diet also may be correlated with dysmenorrhea (Neti Sundari *et al*, 2020). Menstrual discomfort can be a common ailment experienced by 50-90% of adolescent girls and women of reproductive age, characterized by painful menstrual phases. Although the underlying cause of primary dysmenorrhea is still unknown, it is believed to be due to excessive prostaglandin production in the uterus as a denoted cause. Prostaglandin inhibitors are often successful in relieving pain, and their prolonged use may lead to side effects, including but not limited to nausea, stomach distress, and possibly kidney dysfunction. This has made searching for alternative pain relief medication attractive (Rapkin AJ, *et al*, 2012).

Powdered mixes are popular because they are easy to use, convenient, and quick to prepare and contain pre-mixed ingredients. Instant powdered drinks, particularly, are popular with children and adults. This is a new natural remedy developed by Nutri Mix for natural Menstrual pain relief for overall well-being, pain control, and managing discomfort related to dysmenorrhea. This Nutri Mix contains Amaranth flour, Ginger powder, Chocolate, Chia seed, and Fenugreek, outlining the unique benefits of each in relieving menstrual discomfort. Overall, this Nutri Mix combines the nutritional and therapeutic abilities of five powerful ingredients.

Amaranth, a highly nutritious pseudo-cereal rich in health-supporting benefits, has emerged as a top prospect for promoting global food security with research into sustainable and indigenous plants. Amaranth has garnered a considerable amount of renewed interest in science and technology due to its inherent beneficial biological properties, variety of phytochemicals, and wide potential for therapeutic uses. The plant, as a pseudo-cereal, is characterized by its two appropriate food and health-supporting qualities. When viewed as a true cereal, amaranth grain is amongst a few cereals that are highly nutritious pseudo cereals, with a more significant concentration of protein present in its edible grain. The nutritional characteristics are full of essential nutrients, and it has unique characteristics that verify its medicinal uses. Contemporary global food security relies on the rationale role of sustainable indigenous plants (Smyth, S.J., *et al,* 2021).

Chia seeds, grown from the plant Salvia hispanica, are a distinct and up-and-coming ingredient originating from the southwestern areas of Mexico and Guatemala, and they are becoming more recognized for their nutrition. (Pel´aez *et al* 2019). Chia seeds have also gained prominence as a food ingredient in North America, becoming an official raw material in the United States Department of Agriculture's (USDA) National Nutrient Database. (R., & Vuksan, V. 2013).

Fenugreek (*Trigonella foenum-graecum L.*) is a leguminous plant that provides nutritionally good quality, functional benefits, and is inexpensive. Fenugreek is native to Asia and the Mediterranean region but is grown globally, including China, India, Turkey, Canada, Australia, and Africa (Ahmad *et al*, 2016). Fenugreek seeds contain substantial amounts of proteins, lipids, and biogenic substances, including saponins, flavonoids, choline, carotene, and essential oils. Fenugreek has a protein composition ranging from 235.0 to 246.0 g kg-1 and a lipid composition that varies from 40 to 100 g kg-1. In addition, fenugreek is an excellent source of important minerals like iron, phosphorus, calcium, zinc, and manganese, and vitamins A, B1, C, and nicotinic acid (Mighawal *et al*, 2014).

Jaggery is a natural sweetener from concentrated sugarcane juice that is an unrefined sugar widely used in several parts of the world. It contains the nutrition of sugarcane and is seen as a healthier option than refined sugar. Granular jaggery is produced from concentrated juice that is rubbed with a wooden scraper to crystallize, cooled, and sieved. The desired pH range of the juice is 6.0-6.2, and the striking point temperature of 120°C produces high-quality jaggery with high sucrose content, low moisture, and desirable physical properties. High-quality jaggery can be sun-dried and placed in suitable containers for storage and can be kept for over two years, even in humid climates, with very little change in quality (A. Nath *et al,* 2015). A Project report on jaggery powder manufacturing plant. Chervil Agritech Pvt. Ltd., Gujarat, India. Granular jaggery has a sucrose content of 88.6% and a moisture content of about 1.65%. It also has favorable characteristics such as good color, friability, and crystallinity. When granulated to <3 mm, sun-dried to 2 percent moisture content or less, and packaged in polyethylene or polyester bags or bottles, jaggery can be stored at room temperature for over two years, even during the monsoon season, with little change in its chemical composition and physical properties (P. Hirpara *et al,* 2020).

Ginger has been established to be a strong natural cure for menstrual cramps. It has been proven through studies that ginger is equal to conventional pain drugs such as Novafen, mefenamic acid, and ibuprofen in alleviating the intensity and duration of dysmenorrhea. Ginger was found to have a significant effect on pain reduction, as compared to using the visual analog scale, and muscle relaxation through research. These results indicate that ginger may be a safe and efficient substitute for traditional painkillers for women with menstrual pain. Ginger has been known to possess numerous health benefits, such as preventing cancer, alleviating nausea and vomiting related to pregnancy and chemotherapy, and its anti-spasmodic effects. One study recently aimed at comparing how ginger compares with Novafen, a widely used painkiller, in reducing pain during menstruation among female students. The study wanted to investigate whether ginger would provide a natural and potentially safer solution to conventional painkillers in easing menstrual discomfort among female students. The study wanted to investigate whether ginger would provide a natural and potentially safer solution to conventional painkillers (H.A., rad *et al*, 2018).

Chocolate is a nutritional powerhouse, containing vitamins A, B1, C, D, and E, as well as antioxidants such as phenols and flavonoids. It contains essential minerals such as calcium, potassium, and iron, as well as healthy fats such as omega-3 and omega-6 fatty acids. Chocolate's high magnesium content can relieve menstrual cramps and premenstrual symptoms.

Aside from its nutritional benefits, chocolate has long been celebrated for its mood-altering capability, due to its high concentration of vitamins and minerals that induce the release of endorphins. Dark chocolate, with more cocoa content, possesses anti-inflammatory properties that can help alleviate pain.

Chocolate's lovely taste and tendency to stimulate the release of serotonin and endorphins have made it everyone's favorite, particularly among adolescents. These endorphins stimulate the natural pain-killing system of the brain by blocking prostaglandins and pain pathways. Chocolate is also rich in copper, which the body utilizes for synthesizing collagen and neurotransmitters such as endorphins, natural pain killers, and tranquilizers. This study will examine the efficacy of dark chocolate in alleviating dysmenorrhea

1.1 SCOPE OF THE STUDY

Nutri-mix powder that contains Amaranth seed powder, fenugreek seed powder, ginger powder, chia seeds, and dark chocolate helps in the relief of menstrual pain and dysmenorrhea.

Nutri-mix powder is formulated as a food supplement for adults, children. Nutri-mix is a complete mineral, vitamin, and fiber-rich supplement that can properly balance the mineral and vitamin levels.

Nowadays, consumers are increasingly seeking a product that is not only nutritious but also ready-to-eat items so this Nutri- mix powder can be prepared within minutes and helps to retard the pain cause during menstruation.

1.2 OBJECTIVES OF THE STUDY

1. Development and standardization of the functional Nutri-mix based on Amaranth seed powder, fenugreek seed powder, chia seed, ginger, and chocolate.

2. Analysis of sensory and nutritional properties of the developed Nutri-mix for alleviating dysmenorrhea.

3. Shelf-life study of the functional Nutri-mix.

Scope of the study

Nutrix mix powder that contains Amaranth seed powder, fenugreek powder, ginger, chia seeds, and dark Chocolate helps in the relief of menstrual pain and dysmenorrhea.

CHAPTER 2

REVIEW OF LITERATURE

2.1. DYSMENORRHEA

Dysmenorrhea Teenagers often suffer from dysmenorrhea, or menstrual pain, which causes discomfort in the back and lower abdomen. Even though dysmenorrhea is common, it frequently goes untreated, which has several detrimental effects. These include exhaustion, weakness, difficulty focusing, disturbances in day-to-day tasks, and even mental anguish. In addition, dysmenorrhea can worsen the quality of life and financial security of people and their families, as well as exacerbate endometriosis. Poor eating habits are a contributing factor to dysmenorrhea. The purpose of this study is to look into how teenage girls' eating habits and menstrual pain are related. A variety of strategies, including both pharmaceutical and non-pharmacological treatments, are used to manage dysmenorrhea. These techniques are meant to lessen the intensity of menstrual discomfort. Typical tactics include medication, psychotherapy, lifestyle improvements, and dietary changes. Important components include a balanced diet full of fruits, vegetables, complex carbs, and regular exercise. It is also thought to be helpful to avoid alcohol and high-fat diets, get enough sleep, and take supplements of vitamins, minerals, and some drugs.
There are currently no specialised clinics in the area to treat dysmenorrhea, despite ongoing scientific research on the condition. In light of the growing use of herbal remedies in Western nations, this disparity underscores the necessity for further investigation into the possible advantages and disadvantages of such treatments. All herbs are not risk-free, though, and there are still worries about possible negative consequences.

2.2. AMARANTH

Fig 2.1

Amaranth, belonging to the genus *Amaranthus spp.*, is part of the Amaranthaceae family. The name "Amaranthus" comes from an ancient Greek word meaning "unfading" or "everlasting," referring to the plant's long-lasting beauty. It's a member of the Amaranthoidea subfamily and has been cultivated since the 6th century BC. Aesop's fables even mention Amaranthus, describing it as a short-lived plant with enduring beauty compared to roses.

Amaranthus is known for its attractive flower arrangements and thrives in home gardens. There are about 60 to 75 species of Amaranthus found worldwide, with only a few cultivated. It originates from temperate, subtropical, and tropical regions. While its true origin is in America, where it was a staple crop for the Aztecs, Mayans, and Incas, Amaranthus has now spread globally. It's cultivated and consumed in various parts of the world, including India, Nepal, China, Indonesia, Malaysia, the Philippines, Central America, Mexico, and Africa. (Olusanya N. Ruth *et al* 2021) .Some Amaranthus species are native to South and Central America, while others are native to Europe, Asia, Africa, and Australia. Amaranth, a plant with a long history of medicinal use, is known for its astringent properties, likely due to compounds like saponins, proto-alkaloids, and betacyanin. Traditional uses include heavy menstruation, acne, dermatitis, and sore throats. Research has explored its potential benefits in various areas, including heart health, neurological function, blood sugar regulation, antibacterial activity, and antioxidant effects. Amaranth is also incorporated into pharmaceutical products for conditions like atherosclerosis, stomach problems, asthma, and infections. Amaranth seeds are used as a spermatogenetic medication, while the flowers are used for menstrual periods. (s. Moazma *et al* 2024) Amaranth seeds are a nutritious food source, particularly the grain, which is used in baking as a gluten-free flour. This makes it suitable for people with gluten sensitivities. Amaranth's high protein content makes it valuable as a standalone food or a fortifier in cereal mixes. Amaranth oil is also gaining popularity due to its health benefits, including lowering blood pressure, improving lipid profiles, and providing antioxidant and liver protection.

The growing number of people with celiac disease has increased the demand for such nutritious products. Amaranth seeds are processed into various products like flakes, flour, porridge, and oil. Its use in functional cookies, partially replacing wheat flour, has resulted in cookies with improved nutritional content. Amaranth oil, rich in unsaturated fats, antioxidants, and polyphenols, is a prime example of a functional food. Extracts from amaranth plants are also a good source of antioxidants, making them valuable for nutraceuticals and functional food ingredients. Finally, amaranth seeds are a rich source of iron, potentially helpful in treating anaemia (N. Sahreen *et al,* 2020).

Certain anti-nutrients, such as tannins, saponins, phytate, oxalates, nitrates, and protease inhibitors, have also been discovered to be present in amaranth. Amaranth grains contain trace levels of saponins, ranging from 0.9 to 4.91 mg/kg, and phytic acid, which ranges from 2.9 to 7.9 g/kg. Amaranth is a safer food to eat than other common cereals like wheat and maize since it contains only trace amounts of protease inhibitors (trypsin and chymotrypsin), and its leaves contain more nitrates than the grains (Jan *et al,* 2023).

2.2.1 NUTRITIONAL CONTENT OF AMARANTH

Amaranth, despite its grain-like appearance, possesses characteristics of both cereals and legumes, both botanically and nutritionally. (S.G.Garrido *et al* 2021) Its protein composition falls somewhere between these two categories, making it a unique blend of nutrients similar to a combination of legumes and rice. Amaranth is rich in soluble fibre, with about 4.2% content, and boasts a protein content ranging from 12.5% to 17.6%. It also has a significant amount of methionine (15.8 milligrams per gram of protein) and lysine (55.8 milligrams per gram of

protein). Interestingly, Amaranth has a lower concentration of storage protein (42% of the total) compared to wheat and other grains, which have higher amounts. The lipid content in Amaranth varies depending on the variety and genetic makeup, ranging from 1.9% to 9.7%. The seed oil is rich in palmitic, oleic, linoleic, and linolenic fatty acids, and it also contains a significant amount of squalene (6-8%), which has been linked to potential cholesterol-lowering benefits. In addition to its protein, fibre, and fat content, Amaranth is also a good source of carbohydrates, vitamins, and minerals.

Nutritional composition of amaranth

Components	**Percentages**
1. Carbohydrates	68.1
2. Proteins	14.6
3. Fats	6.04
4. Ash	2.40
Components	Concentration (mg)
Dietary Fiber	6.7
Vitamin A	02
Vitamin B	591
Vitamin C	4.2
Vitamin E	82
Folate	557
Phosphorous	508
Potassium	7.61
Iron	

Table **2.1**

Source: (s.moazma *et al,* 2024)

2.2.2 MINERAL COMPOSITION OF AMARANTH FLOUR

Amaranth grain flour is a rich source of essential minerals, including zinc, manganese, magnesium, iron, and calcium. It contains 6.27 mg/100 g of zinc, 5.96 mg/100 g of manganese, 18.23 mg/100 g of magnesium, 11.00 mg/100 g of iron, and 3.39 mg/100 g of calcium. The iron content in amaranth flour is five times higher than that found in soy plantain flour, while the calcium content is similar. These minerals are crucial for normal cell function and growth. The high mineral content of amaranth grain flour makes it a valuable source of micronutrients, particularly for vulnerable populations in Nigeria. Mineral composition is shown in Table 2.

Mineral composition of Amaranth grain flour.

Minerals	Amounts (mg/100 g)
Zn	6.27
Mn	5.96
Mg	18.23
Fe	11
Ca	33.29

Table 2.2 Source: (Moazma *et al,* 2024**)**

2.2.3 HEALTH BENEFITS OF AMARANTH

Amaranth's high protein quality offers bioactive proteins and nutrients as well as significant promise for promoting health and preventing chronic non-communicable diseases. The possible bioactive function and health advantages of various. Extracted from amaranth, the lunasin peptide has been associated with anticancer, antihyperlipidemic, antidiabetic, and anthelmintic properties. The antioxidant, antihypertensive, immunomodulatory, hepatoprotective, and anticarcinogenic properties of certain peptides are among the additional effects being studied. Commercial goods can be made using amaranth hydrolysates as food additives or functional components. the advantages of amaranth grain proteins incorporated into food systems, a few of which demonstrate its potential as a food additive and its practical use. For instance, wheat noodles were developed with amaranth protein as a component

2.3 COCOA POWDER

fig 2.3. cocoa powder

Theobroma cacao L., a tree found in tropical climates that remains green all year, produces cocoa that is made from its seeds, which are a plentiful source of phytochemicals. Polyphenols in cocoa are by far the most ubiquitous group of compounds, and the polyphenols in cocoa have been studied thoroughly for their biological activity, including antioxidant, anti-inflammatory, anti-cancer, or anti-apoptotic activities. The potential health benefits of cocoa have also been explored in several clinical setting, including cardiovascular disease, gastrointestinal health, neurological health, vascular health, and several other diseases. (Cinar

et al, 2021). According to European legislation, cocoa powders are classified based on their fat content. Cocoa powder is identified as the powdered product derived from prepared, shelled, and roasted cacao beans, containing more than 20% cocoa butter and no more than 9% water. In contrast, fat-reduced cocoa powder is identified as having less than 20% cocoa butter (Razola-Díaz *et al,* 2023).

2.3.1 COCOA DARK CHOCOLATE

Dark chocolate has an abundant variety of bioactive components, including polyphenols and flavonoids, and procyanidins, which all add to its large potential health benefits. In addition to dark chocolate's notoriety for beneficial health effects, its association with improved cognition and mood has also been substantiated, potentially due to the effects of increasing blood flow to the brain, as well as the well-known positive effects of other purposeful compounds, like theobromine and caffeine. Indeed, when it comes to overall health, dark chocolate has demonstrated considerable utility, including helping regulate blood glucose levels, making it a good choice for glycemic control and overall health, especially if compared to white chocolate, which has similarly high sugar content (Dehghani *et al,* 2024).

A broad selection of cocoa-based drinks is present in the marketplace, offered in several formats, including hot or cold drinks, with either milk or water, ready-to-drink or instant drinks, and so on. Such drinks are typically made from cocoa powder, although many hot chocolate drinks are made from chocolate. A variety of commercial cocoa-based drinks often contain sugar levels that exceed either natural sugar levels or those of other sugar-alternative drinks to combat bitterness and increase solubility. These sugar levels and beverages have also been associated with health issues, such as obesity and diabetes, which has prompted the food industry and scientists to seek out sugar alternatives. Furthermore, some cocoa-based drinks may include other ingredients, including vitamins, stabilizers, and minerals to enhance their health benefits and improve shelf-life (Benkovi´c *et al*., 2019).

2.3.2 NUTRITIONAL COMPOSITION

Dark chocolate is considered a food dense with nutrients, well known for having high concentrations of bioactive compounds and nutrients. It is known to be high in antioxidants, including polyphenols and flavonoids, to support many health benefits, including cognitive and cardiovascular benefits. The polyphenol content of dark chocolate can vary widely; some studies report levels as high as 39.82 mg/g GAE, and flavonoids can be reported as high as 37.85 mg/g of CE, both of which would support antioxidant activity (Jaćimović et al, 2022). In addition to the above, dark chocolate (in moderation of course) is an excellent source of copper - an important component in the production of a neurotransmitter (endorphins) that acts as a natural pain killer and sedative in the body that may help reduce menstrual pain in adolescents who experience dysmenorrhea (F., Ferina *et al* 2023).

2.4 CHIA SEED

2.4 Chia seed

Chia seeds (Salvia hispanica) are a great source of dietary fibre, containing a whopping 56.4 g/100 g. Most of this fibre is insoluble (53.45 g/100 g), but there's also a soluble component. Chia seeds are known for their ability to absorb water and bind to other molecules, making them a good source of fibre compared to other sources like soybeans, wheat, maize, and wheat hulls. This ability to absorb water and bind to molecules also makes chia seeds effective at emulsifying and stabilising emulsions (Y.D. Ding *et al,* 2016).

Many ailments linked to civilisation, including diabetes, heart disease, and obesity, can be avoided with proper nutrition. To preserve human health, prevent the onset of certain diseases, and lessen their symptoms, both governmental and non-governmental organisations advocate certain foods. Bioactive food ingredients are being given more and more credit for their function in boosting health. They are nutritional or non-nutritional substances that are naturally present in the raw material or created in the product via technological processes. Biesalski and colleagues described them as such, and they have the potential to improve, hinder, or alter the body's physiological and metabolic processes. This definition is further supported by the American Dietetic Association, which emphasises the significance of bioactive foods' safety for human health. Examples of bioactive substances are fatty acids, probiotics, prebiotics, polyphenols, carotenoids, phytoestrogens, sterols, stanols, vitamins, dietary fibre, and bioactive peptides (Kileweli-katunzi *et al*, 2021)

Salvia hispanica, commonly referred to as chia, is one raw component that food scientists and nutritionists are particularly interested in. "Chia" means "oily" in Nahuatl and is a Spanish variant of "chian" or "chien." The herbaceous plant chia has been used for medicinal purposes for thousands of years. These days, chia seeds are used as ingredients or additives in many different foods, including cereals, baked goods, salads, fruit smoothies, and dairy products. Additionally, they thicken sauces and soups. With an emphasis on their chemical makeup, health-promoting qualities, and the laws governing their use in food production, this article aims to provide up-to-date information on the possible applications of chia seeds in the food industry. (B, Kulczyński *et al,* 2019)

2.4.1 CHEMICAL COMPOSITION OF CHIA SEED

Chia seeds are a nutritional powerhouse, packed with essential macronutrients like protein, fats, carbohydrates, and dietary fibre. They also boast a rich profile of micronutrients, including vitamins, antioxidants, and minerals. The high fibre content, exceeding 30% of the seed's weight, makes chia seeds a valuable dietary addition. The diverse array of phytochemicals, including phenolic compounds, flavonoids, tocopherols, steroids, and carotenoids, contributes to the health benefits associated with chia seed consumption. These benefits range from improved blood sugar and blood pressure regulation to enhanced gut health.

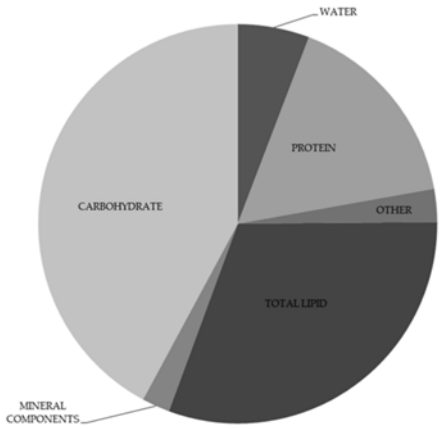


Figure 2.1 Basic composition of chia seed

Source:(Bartosz k *et al* 2019)

Table 2.2Source:(Bartosz k *et al* 2019)

Nutritional value of chia seed

Nutrient	Value
Energy	486.0
Protein	16.5
Total lipid	30.7
Ash	4.8
Carbohydrate	42.1
Dietary fibre	34.4
Calcium	631.0
Iron	7.7
Magnesium	335.0
Phosphorus	860.0
Potassium	407.0
Sodium	16.0
Zinc	4.6
Copper	0.9
Manganese	2.7
Vitamin C	1.6
Thiamine	0.6
Riboflavin	0.2
Niacin	8.8
Vitamin E	0.5
Folate	49.0

2.4.2 FAT COMPOSITION OF CHIA SEED

The content of fat in chia seeds. Various fats and oils are classified according to the structure of the seeds. There have been reports of an overabundance of fatty acids in chia seed oil, particularly polyunsaturated fatty acids (PUFA), which include more than 60% a-linoleic acid and more than 20% linoleic acid (Di Marco et al., 2020; Segura-Campos and colleagues, 2014). The usage of sources derived from plants, which include polyunsaturated fatty acids (PUFAs), has increased due to environmental concerns about water sources, including pollution, overfishing, and the use of unapproved fishing gear. Omega-3 fatty acids, which have some nutritional advantages, are among the common PUFAs that researchers are quite interested in. Alpha-linolenic acid, which comes from plants, may help lower the risk of heart disease, fractures, and Type 2 diabetes, according to Rajaram (2014). Table 2 lists the omega-3 and omega-6 fatty acid makeup of several seeds, including chia seeds. Chia seeds contain a significant quantity of lipids, approximately 40% of their total weight (Table 2). In their 2018 study, Carrillo et al. extracted oil from chia seeds using the Soxhlet process and profiled fatty acids using a gas chromatography-mass selective detector (GC-MSD). According to Carrillo et

al. (2018), the content of omega-3 was 54.08%, omega-6 was 18.69%, and omega-9 was 10.24%. (Ski *et al,* 2019)

Composition of omega 3 and omega 6 of chia seed

Type of oil	Chia
Country of origin	Mexico, Ecuador, Brazil and Argentina
Omega 3	54-67
Omega 6	17-20

Table 2.3

Source:(Bartosz k *et al*,2019)

2.5 JAGGERY

Fig 2.5

Jaggery (Gur) is defined as a product prepared by concentrating the sweet juices of palm trees, or of sugarcane, to solid or semi-solid state. For example, it can be used for the numerous sweet dishes, which are popular in various nations. For the preparation of some Sali ji sweets, it has particular properties for which people prefer it to white sugar (O.S.N. Manay 2001)

According to FSSAI (2018), “Gur or Jaggery is "the product obtained by boiling or processing juice pressed out of sugarcane or extracted from palmyra palm, date palm or coconut palm". It is a natural sugar and has a sweet, winy aroma and taste. It has a heady perfume and a delicious flavour that falls somewhere between brown sugar and molasses. (A., Nath *et al,* 2015)

Jaggery is an important source of protein, vitamins, and minerals. It is also a potent source of iron, higher in iron and copper than refined sugar. In terms of vitamin content, it is also a better product in the segment of natural sweeteners. It is an energizing food, reportedly purifying blood, helping to maintain liver function, and keeping the body healthy. (L.S.,Gangwar *et al,* 2015)

Types of Jaggery and Their Manufacturing Processes

A. Solid Jaggery

The clarified, filtered cane juice gets pumped into open pans, which are heated with a triple pan furnace, and the bagasse acts as fuel. The herbal clarificant (Deola extract @ 45 g/100 kg juice) is used for the clarification of juice to produce yellowish-white jaggery; its mode of action is to remove suspended colloidal and colour compounds from juice by settlement. It separates into crystallized and syrup, the syrup is then boiled in an open pan with stirring and concentrated to form a final jaggery block in the desired shape and size. (A., Nath *et al,* 2015)

B. Granular Jaggery

Jaggery with Granules

The concentrated slurry (TS 58-60%) is done with a wooden scrapper for grain formation. It is cooled to below 25°C and then sieved for the granular form of jiggery. For good quality jiggery, crystals smaller than 3 mm are more suitable. With an increase in the pH of cane juice up to 6.0 to 6.2 with lime solution, and reaching 120°C for striking point temperature, an excellent quality of granular jaggery with higher sucrose content (around 88.6%) and low moisture (about 1.65%) is obtained. It turns out with good colour, friability, crystallinity. Granules of about 3 mm jaggery while being sundried, reduce moisture content to about 2% or less, and when packed in polyethylene polyester bags or polyethylene bottles, the granules can be stored for longer time in ambient temperatures (more than two years) even during monsoon period with little change in its physicochemical quality. (O.S.N. Manay 2001).

Particulars	Quantity (mg)	Particulars	Quantity (mg)
Mineral		Vitamins	
Calcium	40-100	Vitamin A	3.8
Magnesium	70-90	Vitamin D2	6.5
Potassium	10-56	Vitamin E	111.3
Phosphorous	20-90	Vitamin B2	0.06
Sodium	19-30	Vitamin B1	0.01
Iron	10-13	Vitamin C	7.000
Manganese	0.2-0.5	Vitamin B5	0.01
Zinc	0.2-0.4	Vitamin B6	0.01
Copper	0.1-0.9		
Chloride	5.3		

Table 2.4 Source: (P.,Hirpara *et al* 2020)

2.6 FENUGREEK

Fig 2.6

Also referred to as fenugreek, *Trigonella foenum-graecum L*. is an aromatic species of annual legume in the Fabaceae family. Fenugreek (*Trigonella foenum-graecum L*.) is a multi-purpose, aromatic plant that is a historical and significant source of medicinal potential, as well as an exceptionally diverse phytochemical composition. Fenugreek has served as a traditional medicine for thousands of years in Iranian, Indian, Chinese, and Tibetan systems of medicine. It has names in other languages as well, including Methi in Hindi, Urdu, Punjabi, and Marathi, as well as Hulba in Arabic, and hayseed in English. Fenugreek is thought to be one of the oldest medicinal plants, with recent organised evidence that permits its historical use back to at least 4000 BCE. (M. H. Shahrajabian *et al* 2012). As a diploid species with a consistent chromosome number, fenugreek has been utilized as a medicinal. The leaves may be used fresh or dried for herbs, and the seeds may be used for spice (Zandi *et al,* 2015). Fenugreek, or *Trigonella foenum-graecum,* is an annual herbaceous plant, reaching heights of 30-60 cm. It has a long, pink, cylindrical stem and a finger-like root structure. The stems grow a compound, pinnately stipulate, triangular leaf form with a long petiole. The axillary flowers are 15 cm long which have 5 petals, are hermaphrodite, and are insect-pollinated, producing 2-8 pods per stem. The pods have small seeds (5 mm long), hard, smooth, and yellow to yellow-golden in colour. Fenugreek also has a relatively fast rate of growth and germination within 5-10 days; the first trifoliate leaves after germination appear within 5-8 days of germination. Fenugreek matures in 4-7 months and flowers in mid-summer from June through August, with seeds ripening in late summer. The fenugreek plant may also grow in tropical climates with mild winters or cool summers. (Ahmad *et al,* 2016).

Fenugreek contains long and slim pods and delicate dark green leaves, which have medicinal value and are valued culinary spice in Indian food preparation (Baliga *et al,* 2017). Fenugreek leaves are also characterized by their specialized, thick cartilaginous petioles, which are considerably swollen at the top (Aasim *et al,* 2018). Fenugreek is full of medicinal benefits, and is a great dietary supplement choice because it is rich in nutrients which provide nutrition as well as essential protein, carbohydrates, fats, and amino acids. Fenugreek seeds have medicinal properties as well, because of the bioactive compounds in the seeds that are precursors for pharmaceutical and hormonal medications (Mahmood and Yahya 2017).

Domain	Eukarya
Kingdom	plantae
Division	Magnoliophyte
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Sub-family	Trifoliae
Genus	Trigonella
Sub-genus	Foenum graecum
Species	*Trigonella foenum-graecum*

Table 2.5 Botanical classification of *T. foenum graecum* (M.H. Shahrajabian *et al* 2021)

2.6.1 FENUGREEK SEED

Fig 2.7

Located within a large, corneous and translucent endosperm (appears white) is the embryo (yellow structure inside a large kernel) of the fenugreek seed, which serves as the source of nourishment needed for the development of the embryo (Wani and Kumar 2018). Fenugreek contains large amounts of nutrient content consisting of carbohydrates (45%–60% with mucilaginous fibre (e. g. galactomannans)), with protein (20%–30%), fixed oils (lipids) (5%–7%) and bios active compounds, such pyridine alkaloids (trigonelline), choline, free amino acids (e.g. 4-hydroxyisoleucine), minerals, vitamins and other phytonutrients (Wani and Kumar 2018). The relatively high amounts of protein in fenugreek make it an easily obtained, affordable protein versus expensive and often scarce animal protein. Specifically, fenugreek contains spiralling amounts of essential amino acids, including high concentrations of 4-hydroxyisoleucine, lysine, aspartic acid, arginine, leucine, tryptophan, histidine, and isoleucine (Aljuhaimi *et al 2017*).

Components	Seeds
Moisture	-
Protein	30g
Fat	7.5g
Fibre	50g
Calcium	160mg
Magnesium	160mg
Iron	14mg
Sodium	19mg

Potassium	530mg
Vitamin C	43mg
Beta carotene	96µg
Thiamine	340µg
Riboflavin	290µg
Nicotinic acid	1.1µg
Folic acid	84
Trigonelline	380mg

Table 2.6 Value expressed per 100g (M.H. Shahrajabian et al. 2021)

2.7 Ginger (Zingiber *officinale*)

Fig 2.8

The ginger plant, *Zingiber officinale*, is acknowledged for its numerous medical benefits and has been known as a herbal plant for an extended period. (O.Sadeghp and L.,Khodaie,2015)

Compounds like gingerol, shogaol, and zingerone from ginger have stimulated much research about their antioxidant, anti-inflammatory, and anticancer activities. (P.,Ballester *et al,* 2022)

Ginger is widely used to treat coughs due to its cough expectorant properties that facilitate the loosening and expelling of phlegm from the lungs. Ginger is also known to relieve pain, treat vomiting and nausea, help in poisoning, and aid in digestion. The rhizome, or underground stem, is the part of the plant that is most commonly eaten. Ginger's tuberous rhizomes have gained popularity in the recent past due to their claimed beneficial properties, like anti-inflammatory, antioxidant, anti-apoptotic, antiviral, and antibacterial activities. (M.,Talebi *et a,l* 2021)

Ginger bioactive compounds exert their analgesic and anti-inflammatory actions through the inhibition of COX2 and LOX pathways and thus, suppressing the metabolism of arachidonic acid. The effect of ginger is similar to that in the family of NSAIDs (I., Kravchenko *et al,* 2019).

Amino Acids (g/100g protein) Ginger	Ginger
Glycine	1.36 ± 0.18
Alanine	1.85 ± 0.00
Serine	1.56 ±0.02
Proline	3.89± 0.29
Valine	1.77±0.03
Threonine	4.08±0.71
Lysine	6.85±0.00

Table 2.7 Source: (O.,J.Onyema *et al,* 2024)

CHAPTER 3

MATERIALS AND METHODOLOGY

3.1 INTRODUCTION

This chapter discusses the materials and methods used to develop functional Nutri-Mix powder, including amaranth seed flour, ginger, fenugreek, and cocoa powder, for alleviating dysmenorrhea. This study was carried out at the Department of B.VOC Food Processing Technology, St. Teresa's College, Ernakulam, during the year 2024-2025.

3.2 MATERIALS REQUIRED

1. Amaranth seed flour: fig 3.1
2. Cocoa powder (dark chocolate): fig 3.2
3. Fenugreek seed: fig 3.3
4. Ginger powder: Fig. 3.4
5. Chia seed: fig 3.5
6. Jaggery powder: Fig. 3.6

Fig 3.1

Fig 3.2

Fig 3.3

Fig 3.4

Fig 3.5

Fig 3.6

3.3 EQUIPMENT AND APPARATUS REQUIRED

1. Mixer grinder: Fig. 3.7

2. Weighting machine: Fig. 3.8

3. Sieve: Fig. 3.9

4. Mortar and Pestle: Fig. 3.10

Fig 3.7

Fig 3.8

Fig 3.9

Fig 3.10

3.3.1 MIXER GRINDER

An apparatus for combining and grinding different culinary components is a mixer grinder. It is compact and plays an important role in preparing food. This appliance made our task easy when it came to trying out our culinary skills. One of the main features of mixer grinders is their capacity to quickly and precisely grind and mix different culinary components. These gadgets are ideal for use in environments where food is made because they are usually quite easy to maintain and clean.

3.3.2 WEIGHING MACHINE

A weighing machine is a device used to measure weight or mass. These are also known as mass scales, weight scales, mass balances, massometers, and weighing balances. The digital weighing scale has a small LCD that shows the weight and is simple to use. Digital scales are generally more accurate and precise than mechanical scales, usually having a touch screen interface these days, and come in various sizes, ranging from pocket-sized scales to large industrial scales. These types of weighing scales are typically used in laboratories, medical facilities, and industrial settings.

3.3.3 SIEVE

Sieve is a device with meshes or perforations through which finer particles of a mixture (as of ashes, flour, or sand) of various sizes may be passed to separate them from coarser ones, through which the liquid may be drained from liquid-containing material, or through which soft materials may be forced for reduction to fine particles. The mesh size of the plates can vary depending on the intended use, such as separating wheat husks and stones.

3.3.4 MORTAR AND PESTLE

mortar and pestle, an ancient device for milling by pounding. The mortar is a durable bowl, commonly made of stone, ceramic, or wood. The pestle is a rounded grinding club often made of the same material as the mortar. The mortar is bowl-shaped and used to hold the substance to be ground. Mortars have smooth, rounded bottoms and wide mouths. The pestle is a stick used for pounding and grinding. They used to crush various ingredients and used to grind herbs.

3.4 PREPARATION OF NUTRI-MIX POWDER

3.4.1 SELECTION OF RAW MATERIAL

In this study, the selection of raw materials is crucial, so meticulous attention was given to procure high-quality raw materials to create nutritionally rich Nutri-Mix powder with amaranth seed powder, ginger, fenugreek powder, and cocoa seed for alleviating dysmenorrhea.

Each ingredient is selected according to its nutritional health benefits. In addition to the amaranth seed powder, fenugreek powder, ginger, and cocoa powder, essential ingredients such as chia seeds and jaggery are carefully selected from the market. They also contributed to the taste and texture of the product.

3.4.2 PREPARATION OF RAW MATERIAL

In this study, meticulous attention was given to the procurement of premium-quality raw materials to ensure the creation of a distinctive, nutritionally rich Amaranth seed powder-based Nutri Mix with Cocoa Powder, chia seed, ginger powder, and fenugreek powder. The sourcing process began with the acquisition of premium-grade Amaranth seed powder from reputable market sources, ensuring its optimal Freshness and nutritional value.
To further elevate the health benefits of the Nutri mix, Chia seeds were procured from an organically grown garden, ensuring their purity and adherence to sustainable agricultural practices.

To prepare the Nutri-Mix powder, we must grind and powder all ingredients. These ingredients were chosen based on their superior quality, ensuring that they would contribute to the overall taste, texture, and nutritional profile of the Nutri mix to reduce Dysmenorrhea

3.4.3 PROCEDURE

For the development of this Nutri-Mix powder. We must grind every ingredient, and to achieve the appropriate taste and texture must mix the powdered ingredients in different proportions.

And it is consumed by mixing 1 teaspoon of Nutri-Mix powder into 250 ml of boiled or warm water. It can be prepared within minutes.

3.4.4 DEVELOPMENT OF NUTRI-MIX POWDER

Figure 3.11: powdered ingredients.

Figure 3.12 Mixed powdered ingredients

The Nutri-Mix was prepared by combining the ingredients in 5 different ratios to find the appropriate compositions. The ingredients for all 5 samples [S1, S2, S3, S4, S5] were taken on different plates. They were prepared according to the procedure. The best taste and textural properties were exhibited by the S4, and thus it was selected for further studies.

Table 6.1 Composition of Ingredients Taken for Different Trials

Sample	Amaranth seed powder (g)	Cocoa powder (g)	Jaggery (g)	Chia seed (g)	Ginger powder (g)	Fenugreek powder (g)
S1	25	30	15	10	10	10
S2	30	25	15	10	10	10
S3	35	20	15	10	10	10
S4	40	20	15	10	10	10
S5	45	10	15	10	10	10

3.5 SENSORY NUTRITIONAL AND SHELF-LIFE ANALYSIS

3.5.1 SENSORY ANALYSIS

HEDONIC RATING SCALE

On February 13, 2025, a sensory assessment was conducted involving three B. Voc Food Processing Technology students and Two Assistant professors from the department of Food Processing Technology. These evaluators were provided with a 5-point Hedonic scale and score card to assess five food samples.

Table 3.2: Hedonic rating scale

5-point Hedonic scale

5	Like a lot
4	Like a little
3	Neither like nor dislike
2	Dislike a little
1	Dislike a lot

Table 3.3: Hedonic Rating provided by Sensory Evaluation

Food Analysis	Sample	Appearance	Colour	Texture	Flavour	Taste	Overall Appearance
Analyst 1	S1	3	2	2	3	3	2.6
	S2	4	3	3	3	3	3.2
	S3	3	3	2	3	3	2.8
	S4	3	3	3	4	4	3.4
	S5	4	4	3	3	3	3.4
Analyst 2	S1	3	3	3	2	2	2.6
	S2	3	4	3	3	3	3.2
	S3	3	3	3	2	3	2.8
	S4	3	3	4	4	4	3.6
	S5	4	3	3	2	3	3
Analyst 3	S1	3	3	3	3	3	3
	S2	3	4	4	3	3	3.4
	S3	3	3	2	3	4	3
	S4	4	5	4	5	5	4.6
	S5	3	4	2	4	4	3.4
Analyst 4	S1	3	3	2	2	2	2.4
	S2	4	4	3	3	2	3.2
	S3	4	4	4	3	3	3.6
	S4	4	4	4	4	4	4
	S5	3	4	3	4	4	3.6
Analyst 4	S1	2	2	3	2	2	2.2
	S2	2	3	2	2	2	2.2
	S3	2	3	3	3	3	2.8
	S4	3	4	3	4	4	3.6
	S5	2	3	3	3	3	2.8

3.5.2 NUTRITIONAL ANALYSIS

3.5.2.1 METHODS FOR ANALYISING VARIOUS PARAMETERS OF NUTRI-MIX POWDER

3.5.2.1.1 TOTAL ASH (AOAC 22nd Edn. 2023 923.03 Ch.32.1.05**)**

APPARATUS

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

PROCEDURE

- Weigh accurately about 5g of powdered sample in a crucible.
- Ignite the sample in the crucible with the flame of a suitable burner for about one hour. Transfer the crucible into a muffle furnace at 500±10°C until grey ash results.
- Cool the crucible in a desiccator and weigh.
- Repeat the process of igniting, cooling, and weighing at half-hour intervals until the difference in mass between two successive weighings is less than one milligram.
- Record the lowest mass obtained.

CALCULATION

Total ash (on dry basis), percent by mass = 100 (M2- M) ×100 ÷ M1-M ×(100-W)

Where M1 Mass, in g of dish, with the material taken for a test

M2 Mass in g of dish with ash

M = Mass in g of the empty dish

W = Moisture% % of the sample

3.5.2.1.2 CARBOHYDRATES (AOAC 22nd Edn. 2023;986.25, ch.50.1.16**)**

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

3.5.2.1.3 ANALYSIS OF FAT

Accurately weigh 5g of the substance in a suitable thimble, then let it dry for two hours at 100°C. The thimble should be placed in the Soxhlet extractor derive and extracted with petroleum Ether at 40-60°C for eight hours. Dry the extract in the Soxhlet flask, whose empty mass was earlier measured by taring at 95-100°C for an hour. Desiccate and weigh after cooling. Continue drying, chilling, and weighing at intervals of 30 minutes until there is a mass change of more than 2 milligrams between two subsequent weighings. Record the lowest mass obtained.

The percentage fat was calculated as follows,

$$\text{Fat \% by mass} = 100\times (M_1 - M_2) / M$$

Where M1 Mass in g of Soxhlet flask with the extracted fat

M2 = Mass in g of empty Soxhlet flask

M = mass in g of the material taken for the test

3.5.2.1.4 ANALYSIS OF MOISTURE CONTENT

APPARATUS

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

PROCEDURE

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

CALCULATION

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

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

$M_{2 = mass}$ in g of dish with material after drying too constant mass, and

M = mass in g of the empty dish

3.5.2.1.5 ANALYSIS OF PROTEIN (AOAC 20th Edn 2016 .920.152)

PRINCIPLE

The test portion is digested in H2SO4, using HgO as a catalyst, converting nitrogen to NH3, which is distilled and titrated.

REAGENTS

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

PROCEDURE

- Accurately weigh 0.70 to 2.20g of the sample into the digestion flask
- Add 0.7g HgO and 15g Na2SO4.
- Add 25ml of Sulphuric acid.
- Place the flask in an inclined position on a heater and heat gently until frothing ceases
- Boil until clear.
- Cool and add about 200ml distilled water and cool to room temperature
- Add 25ml Thiosulphate solution (8% in water) and mix to precipitate mercury.
- Add sodium hydroxide solution more carefully through the sides of the flask to make the solution strongly alkaline
- Assemble the apparatus taking care that the tip of the condenser extends below the surface of a known quantity of standard sulphuric acid and add 5-7 drops of methyl red indicator
- Heat immediately until all ammonia has distilled (150ml)
- Lower the receiver before stopping distillation and wash the tip of the condenser with distilled water.
- Titrate against std. Sodium hydroxide solution
- Correct for blank determination on reagents

CALCULATION

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

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

3.5.2.1.6 ENERGY

TEST METHOD

Pearson's composition & analysis of food- 9th Edn. Page-6-1991

SCOPE

Method of determination of energy value in Food grains

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

3.5.2.1.7 IRON

REAGENTS

- O-phenanthroline solution
- α,α-Dipyridyl solution
- iron standard solution
- Hydroxylamine hydrochloride solution
- Magnesium nitrate solution
- Acetate buffer solution

PROCEDURE

By dry ashing:

Ash 5.00g test portion in Pt, SiO_2, or porcelain dish. Cool and weigh if percent ash is desired. Continue ashing until practically C-free. To diminish ashing time, or products that do not burn practically C-free, use one of the following ash aids: Moisten ash with 0.5- 1.0 ml Mg (NO3)2 solution or with redistilled HNO3Dry and carefully ignite in furnace, avoiding spattering. (Do not add these ash aids to self-rising flour (products containing NaCl) in Pt dish because of vigorous action on the dish.) Cool, add 5 ml HCI, letting acid rinse the upper portion of the dish, and evaporate to dryness in a steam bath. Dissolve residue by adding 2.0 ml HCI, accurately measured, and heat 5 min on a steam bath with a watch glass on the dish. Rinse the watch glass

and dilute the residue solution to 100 mL with H2O. If necessary, filter diluted residue solution through ashless paper and discard the first 15-20 ml of filtrate. Pipet 10 ml aliquot into 25 ml volumetric flask and add 1 ml H2NOH.HCI solution; stand for 5 min. Add 5 ml Acetate buffer solution and 1 ml o - o-phenanthroline, or 2 ml dipyridyl solution, and dilute to volume. Determine absorbance in a spectrophotometer at ca 510 nm. From reading, determine Fe concentration from equation of line representing standard points or by reference to standard curve for known Fe concentration If further dilution required to maintain test solution absorbance reading below highest standard point on curve, pipet smaller Aliquot into 25.0 ml flask, dilute to 10 ml with 2% HCl solution and continue as described in above procedure. Determine the blank on the reagents and make corrections.

Calculate Fe in flour as mg/lb.

3.5.3 SHELF LIFE

Consumers are demanding high-quality food products and expecting the product to be maintained at a high quality during the period between the purchase and consumption. Shelf life is the length of time for which an item remains usable, fit for consumption, or sealable.is influenced by both intrinsic and extrinsic factors, including Temperature, moisture, light, microbial growth, use of preservatives, Relative humidity, nutrients, etc. Shelf life must be mentioned in the labelling of a product, and it is a crucial part.

The Nuti-Mix powder is made by combining Amaranth seed powder, cocoa powder, ginger powder, fenugreek powder, chia seed, and jaggery as ingredients. The product is packed in a glass jar and a paper bag. In a glass jar, the product is tightly closed with the lid. The paper bag with the product is tightly covered, keep it in a Zi pouch. Both samples are placed at room temperature.

Each sample is labelled with the date of production, and it is inspected weekly. On the daily assessment, it is clear that both products can be kept in a glass jar and a paper bag. Neither the sample nor the control shows any sign of spoilage in the first week; the texture and aroma are the same. By entering the second week, there is only a slight difference in the colour of the powder compared with the first week. From this, we can conclude that the powder if we keep the powder in a dry place in an airtight glass container, it will have a shelf life of more than one or two weeks.

Fig. 3.13 Nutri mix before 2 weeks

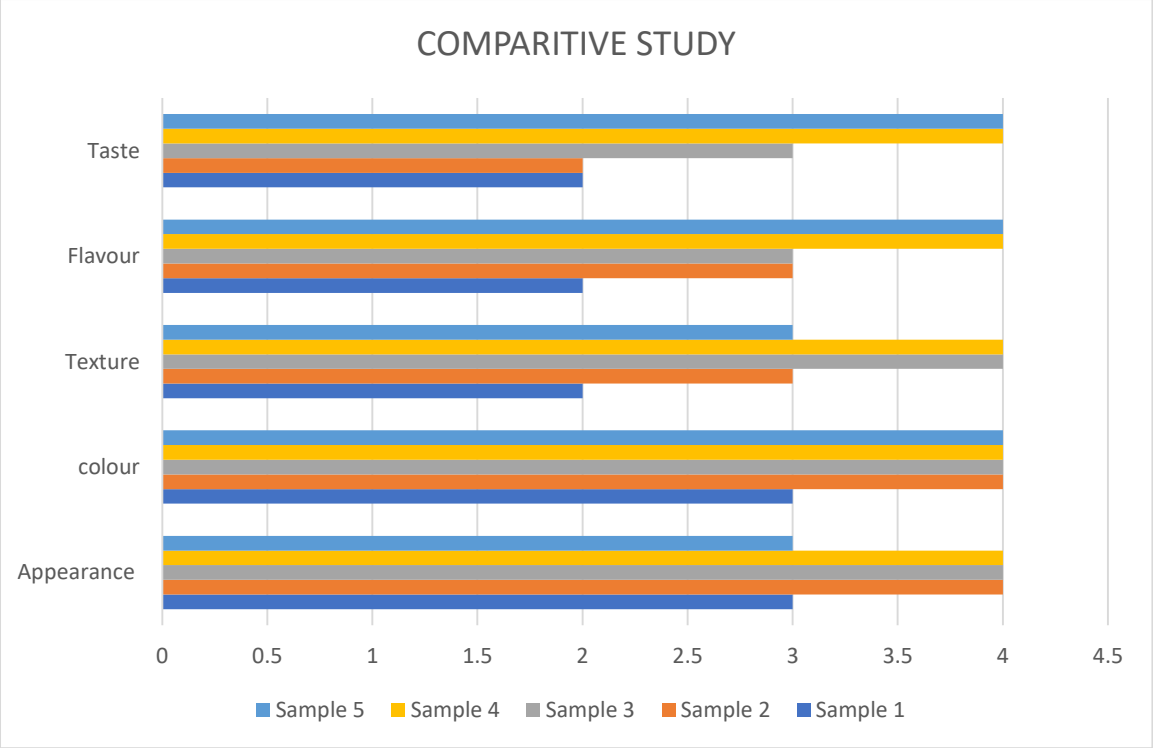
Fig. 3.14 Nutri mix after 2 weeks

CHAPTER 4

RESULT AND DISCUSSION

This chapter presents the findings and discussion derived from the observation conducted in the present study titled “Synergistic Effects of Amaranth Seed Flour, Ginger, Fenugreek, and Cocoa Powder in a Functional Nutri-mix for Alleviating Dysmenorrhoea”. The primary aim of this study was to develop a Nutri-Mix powder for alleviating menstrual pain. Specifically, the study aims to develop a convenient product that can be consumed during menstruation to decrease pain and discomfort at that time. To achieve this goal, Nutri-Mix powder containing Amaranth seed powder, Fenugreek powder, Cocoa chocolate powder, Jaggery powder, and Chia seed powder was developed. Subsequently, sensory evaluation and nutritional analyses were performed to assess the quality and nutritional content of the Nutri-Mix powder. The results of these assessments are provided below:

4.1 SENSORY EVALUATION



GRAPH 4.1.1: Comparative study of five samples based on sensory analysis using a hedonic scale

The graph states that the accepted sample is S4 and the least accepted sample is S1. There is only a slight difference in the aroma, colour, and texture. S1 appears to have the least taste, likely due to its higher concentration of Amaranth seed powder.

4.2 NUTRITIONAL ANALYSIS

Parameters	Unit	Test result
Moisture	g\100g	11.3
Total ash	g\100g	6.27
Protein	g\100g	14.1
Fat	g\100g	4.88
Carbohydrate	g\100g	63.5
Energy\Calories	Kcal\100g	354
Iron	mg\100g	7.31

Table 4.1 sample 1

Parameter	Unit	Test result
Moisture	g\100g	8.23
Total ash	g\100g	3.85

Protein	g\100g	12.6
Fat	g\100g	4.40
Carbohydrate	g\100g	70.9
Energy\Calories	Kcal\100g	374
Iron	mg\100g	6.64

Table 4.2 sample 2

4.3 SHELF LIFE

Shelf life, a pivotal aspect in the food industry, pertains to the duration during which a food product remains safe and maintains its quality from the time of purchase to consumption. Numerous factors, such as water activity, pH, redox potential, oxygen, nutrients, natural microflora, preservatives, time, temperature, and relative humidity, significantly impact the shelf life of a product. Manufacturers must disclose this information on the product's label to ensure consumer satisfaction and safety. From the prepared 5 samples according to the sensory preference, two samples were selected. One is packed in a glass jar and the other is packed in a paper bag; both are kept at room temperature, and each one is labelled as S1 and S2 with the production date and assessed weekly. Upon the daily evaluation, it observes that the aroma and the colour of the sample are getting lighter compared the day one. In these two weeks of evaluation, there is no Mold growth or any other indication of spoilage.

CHAPTER 5

SUMMARY AND CONCLUSION

The research thesis presented above focuses on the Development of NUTRI-MIX made of AMARANTH SEED POWER, CHIA SEED, COCOA POWDER, FENUGREEK, GINGER POWDER, and JAGGERY to alleviate DYSMENORRHEA. This study aims to explore the utility of the Amaranth seed powder combined with other ingredients in the menstrual pain. To achieve this, the study employed a descriptive-quantitative research methodology, which involved preparing five varying ratios of Amaranth seed powder and Cocoa powder in the ratio of S1 (25%+30%), S2(30%+25%), S3(35%+20%), S4(40%+20%), and S5 (45%+20%). The primary objective was to identify the optimal concentration of Cocoa powder that would enhance the sensory attributes of the Nutri-Mix, including colour, taste, texture, and overall accessibility.

The sensory evaluation was conducted using descriptive testing, where a panel of experts assessed the characteristics of the six formulations. The results demonstrated that sample 4,

which contained a 40:20 ratio of Amaranth seed powder and cocoa powder, achieved the highest sensory acceptability rating. This suggests that incorporating cocoa powder in this specific proportion can significantly improve the sensory qualities of the Nutri mix. In addition to the sensory improvements, the proximate analysis of the final product revealed high levels of carbohydrates, Energy, and protein. These findings indicate that the incorporation of Amaranth seed powder not only enhances the sensory attributes of the Nutri mix but also contributes to its nutritional value.

In conclusion, the research thesis provides valuable insights into the potential of using Amaranth seed powder in the food processing sector, specifically in the development of a nutritionally improved Nutri mix powder
The optimal ratio of Amaranth seed powder to wheat flour (40:20) has been identified, which can serve as a foundation for further research and development in this area. The findings of this study may encourage the food industry to explore alternative ingredients and formulations, ultimately contributing to more diverse and nutritious food products.

CHAPTER

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CHAPTER

APPENDICES

SCORE CARD

HEDONIC RATING SCALE

Name:

Product:

Date:

The samples are provided. Taste the sample and check how much you like or dislike each of the characters.

	Appearance	Colour	Texture	Flavour	Taste	Overall acceptance
Sample1						
Sample2						
Sample3						
Sample4						
Sample5						

5 point hedonic scale

5	Like a lot
4	Like a little
3	Neither like or dislike
3	Dislike a little
1	Dislike a lot

Comments: signature:

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TEST REPORT

Kerala State Pollution control Board 'A' Grade Laboratory : PCB/LAB/C15/2018

Test Report No.	:BL/TR/2025/1452	Report issue date	: 01/04/2025

Name & address of the customer: Ms. DevikaBiju St. Theresa's College, Ernakulam	Sample Name Provided by the Customer : Nutrimix Powder
	Sample submitted by : Customer
Sample ID : BL/2025/1452	Sample quantity : 500g
Sampling date (Provided by the customer) : 25/03/2025	Customer Sample ID if any : Date of Mfg:25/03/2025
Sample receipt date : 25/03/2025	Description & condition of the sample: Brown
Analysis performing date : 25/03/2025– 01/04/2025	coloured powder & received in good condition.

CHEMICAL

Sl No	Parameters	Test Method	Unit	Test Result	Limit of Quantification (LOQ)
1	Moisture	IS 12711	g/100g	8.23	0.10
2	Total Ash	IS 12711	g/100g	3.85	0.10
3	Protein	IS 7219	g/100g	12.6	0.10
4	Fat	IS 12711	g/100g	4.40	0.10
5	Carbohydrate	IS 1656 Annex C	g/100g	70.9	-
6	Energy/Calorie	FAO (Food Energy Method)	Kcal /100g	374	-
7	Iron	AOAC Official Method 999.11 (20th Edition)(By AAS)	mg/100g	6.64	0.20

❖ End of report ❖

For Biogenic Labs
Authorized signatory

SANGEETH K.S
LAB MANAGER

Biogenic Labs

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TEST REPORT

Kerala State Pollution control Board 'A' Grade Laboratory : PCB/LAB/C15/2018

Test Report No.	:BL/TR/2025/1451	Report issue date	: 01/04/2025

Name & address of the customer: Ms. DevikaBiju, St. Theresa's College, Ernakulam		Sample Name Provided by the Customer	: Nutrimix Powder
		Sample submitted by	: Customer
Sample ID	: BL/2025/1451	Sample quantity	: 500g
Sampling date (Provided by the customer)	: 25/03/2025	Customer Sample ID if any	: Date of Mfg:14/03/2025
Sample receipt date	: 25/03/2025	Description & condition of the sample: Dark brown coloured powder & received in good condition.	
Analysis performing date	: 25/03/2025– 01/04/2025		

CHEMICAL

Sl No	Parameters	Test Method	Unit	Test Result	Limit of Quantification (LOQ)
1	Moisture	IS 12711: 1989	g/100g	11.3	0.10
2	Total Ash	IS 12711: 1989	g/100g	6.27	0.10
3	Protein	IS 7219	g/100g	14.1	0.10
4	Fat	IS 12711	g/100g	4.88	0.10
5	Carbohydrate	IS 1656 Annex C	g/100g	63.5	-
6	Energy/Calorie	FAO (Food Energy Method)	Kcal /100g	354	-
7	Iron	AOAC Official Method 999.11 (20th Edition)(By AAS)	mg/100g	7.31	0.20

❖ End of report ❖

For Biogenic Labs
Authorized signatory

SANGEETH K.S
LAB MANAGER

SCORE CARD

HEDONIC RATING SCALE

Name: Nandana Nair

Product: Cocoa -Amara Ease nutri-mix powder

Date: 13 - 03 - 2025

The samples are provided. Taste the sample and check how much you like or dislike each of the characters.

	Appearance	Colour	Texture	Flavour	Taste	Overall acceptance
Sample1	3	2	2	3	3	2.6
Sample2	4	3	3	3	3	3.2
Sample3	3	3	2	3	3	2.8
Sample4	3	3	3	4	4	3.4
Sample5	4	4	3	3	3	3.4

5 point hedonic scale

5	Like a lot
4	Like a little
3	Neither like or dislike
2	Dislike a little
1	Dislike a lot

Comments: All the drinks have a little bitter taste. Drink is preferred to porridge.

signature: Nyair

Drink

3

SCORE CARD

HEDONIC RATING SCALE

Name: Aishwarya Sreelakshmi. S

Product: Coosa - Amara Base nutri-mix powder

Date: 13/3/25

The samples are provided. Taste the sample and check how much you like or dislike each of the characters.

	Appearance	Colour	Texture	Flavour	Taste	Overall acceptance
Sample1	3	3	3	3	3	3
Sample2	3	4	4	3	3	3
Sample3	3	3	2	3	4	3
Sample4	4	5	4	5	5	5
Sample5	3	4	2	4	4	4

5 point hedonic scale

5	Like a lot
4	Like a little
3	Neither like or dislike
2	Dislike a little
1	Dislike a lot

Comments: Sample 4 is better than others. signature:

Drink

1

SCORE CARD

HEDONIC RATING SCALE

Name: Pinku Maria

Product: Cocoa-Amara Base nutri-mix powder

Date: 13/03/2025

The samples are provided. Taste the sample and check how much you like or dislike each of the characters.

	Appearance	Colour	Texture	Flavour	Taste	Overall acceptance
Sample1	3	3	2	2	2	2
Sample2	4	4	3	3	2	3
Sample3	4	4	4	3	3	3
Sample4	4	4	4	4	4	4
Sample5	3	4	3	4	4	4

5 point hedonic scale

5	Like a lot
4	Like a little
3	Neither like or dislike
2	Dislike a little
1	Dislike a lot

Comments:

Drink is better when compared to spread.

signature: Pinku.

SCORE CARD

HEDONIC RATING SCALE

Name: ELIZABETH SARINA JACOB

Product: Cocoa - Amara Base nutri-mix powder

Date: 13/02/2025

The samples are provided. Taste the sample and check how much you like or dislike each of the characters.

	Appearance	Colour	Texture	Flavour	Taste	Overall acceptance
Sample1	2	2	3	2	2	2.2
Sample2	2	3 2	2	2	2	2.2
Sample3	2	3	3	3	3	2.8
Sample4	3	4	3	4	4	3.6
Sample5	2	3	3	3	3	2.8

5 point hedonic scale

5	Like a lot
4	Like a little
3	Neither like or dislike
2	Dislike a little
1	Dislike a lot

Comments:

signature: