



Acceptability of Nipa fruit (*Nypa Fruticans*) Brownies

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Abstract

This study explores the potential of Nipa fruit (*Nypa fruticans*) flour as an alternative ingredient in brownie production. It aims to assess the nutritive value of Nipa fruit, determine the process of preparing brownies using Nipa fruit flour, identify the best proportion for baking, evaluate sensory acceptability, examine shelf life, and assess its economic viability as an additional source of income. Given the increasing demand for healthier and sustainable food alternatives, this study highlights the potential of Nipa fruit flour as a nutritious and cost-effective option.

The study employed descriptive and Research and Development (R&D) methods and involved children, students, parents, and teachers from Ponong Integrated School, Ponong, Magarao, Camarines Sur, as respondents. Three formulations of Nipa fruit flour brownies were tested: Formulation 1 ($\frac{1}{2}$ cup of Nipa fruit flour), Formulation 2 (1 cup), and Formulation 3 (1 $\frac{1}{2}$ cups). Sensory evaluation was conducted to assess the brownies' color, taste, aroma, texture, and appearance. The shelf life was determined through physical observation, and economic feasibility was analyzed based on production costs and market potential.

The findings revealed that every 100 grams of Nipa fruit contains 22.8g net carbs, 25.2g carbohydrates, 2.4g fiber, 0.6g fats, 1.7g protein, 4.0mg sodium, 382.0mg potassium, and various essential vitamins and minerals. The preparation of Nipa fruit flour involved peeling, sorting, cleaning, grating, drying, pulverizing, and packaging. Among the tested formulations, Formulation 1 ($\frac{1}{2}$ cup of Nipa fruit flour) produced the most acceptable brownies, characterized by a dark chocolate brown color, moderately sweet and slightly bitter taste, sweet aroma, and a perfectly moist and firm texture. Sensory evaluation results showed that Formulation 1 had the highest acceptability, with a weighted mean of 3.46, indicating a high preference among respondents. The brownies maintained good quality for up to 10 days at room temperature, after which texture changes and mold growth were observed. Additionally, the economic viability of Nipa fruit brownies was promising due to the abundant availability of Nipa

fruit, resulting in low production costs. The product's health benefits and novelty appeal to eco-conscious consumers, suggesting strong market potential.

This study concludes that incorporating Nipa fruit flour in brownies offers a nutritious, economical, and sustainable alternative to traditional ingredients. Following proper flour preparation techniques ensures product quality, and Formulation 1 (½ cup of Nipa fruit flour) is the most suitable for achieving optimal sensory attributes. The moderate acceptability of all formulations suggests that Nipa fruit brownies can be further improved to meet consumer preferences. With effective marketing strategies, this innovative product has the potential to create livelihood opportunities, support local economies, and contribute to sustainable food systems.

Keywords: Nipa Fruit(Nypa Fruticans), Flour, Brownies, Source of Income

Introduction

Incorporating local, abundant, and often underutilized resources like nipa fruit into our food systems can lead to more sustainable and innovative culinary practices. Nipa fruit, despite its versatility, remains largely untapped in the baking industry, yet it holds significant potential, particularly in the production of brownies. This study explored the acceptability of nipa fruit brownies, highlighting their potential as a novel product that could diversify income sources for local communities. By leveraging such resources, we can create economically viable and environmentally friendly alternatives that support both local economies and food sustainability.

The nipa palm, native to coastal regions across Asia and Oceania, provides a wealth of resources, including construction materials and traditional medicines. However, its fruit remains one of the palm's untapped potentials, rich in flavor and nutrients yet largely overlooked in mainstream cuisine. Exploring the nutritional benefits and distinctive taste of nipa fruit offers a unique opportunity to diversify culinary offerings. Additionally, utilizing this resource can empower local communities by creating new economic opportunities and fostering sustainable growth through the use of their natural resources.

Brownies, cherished for their indulgent texture and rich flavor, offer an excellent platform for culinary innovation. By integrating nipa fruit into brownie recipes, this study seeks to explore both the gastronomic allure and the economic viability of this unique fusion. The research will assess the acceptability of nipa fruit-infused brownies across various demographic segments, providing insights into consumer preferences. Additionally, it will evaluate the market potential of these innovative brownies, highlighting the possibilities for commercial success.

Sustainability Development Goal 2 Targets by 2030 to "End Hunger, achieve food security and improved nutrition, and promote sustainable agriculture. The broader goal of achieving zero hunger encompasses various aspects of sustainable agriculture, food security, and improve nutrition. Nipa Fruit, being a potential source of food, could contribute to achieving this goal, especially if its cultivation and utilization align with sustainable practices.

In the Philippines, it is ironic that despite being an agricultural country, widespread poverty continues to result in significant hunger and malnutrition. These challenges hinder the potential of Filipino citizens to become more productive and globally competitive. With the rising inflation rate and the soaring prices of rice and other raw materials, these issues are likely to persist. This situation underscores the need for Filipinos to explore alternative food sources. The consumption of nipa palm fruit, which is rich in nutrients, may offer a solution to the country's malnutrition and hunger problems. This approach aligns with the second of the United Nations' seventeen Sustainable Development Goals (SDGs), known as "Zero Hunger," which was established in 2015 as part of a universal call to end poverty, protect the planet, and ensure prosperity for all by 2030. SDG 2 specifically aims to eliminate all forms of malnutrition and to boost agricultural productivity and income, particularly for farmers and small-scale entrepreneurs.

To achieve sustainable development and meet the UN's Sustainable Development Goals (SDGs) by 2030, innovative solutions are needed to address social and economic challenges while safeguarding the environment. One of the key goals, SDG 2, aims to end hunger by establishing sustainable food systems that ensure access to nutritious food for all. This study contributes to this objective by exploring the potential of nipa fruit-infused brownies as a culinary innovation. By investigating their acceptability, the study not only seeks to introduce a new, nutritious food source but also explores its potential as an income-generating opportunity, thereby aligning with SDG 2's focus on eliminating hunger and fostering economic empowerment.

In addition, this study emphasizes the utilization of locally available raw materials like the Nipa Fruit, which can significantly contribute to the production of local agricultural products. This effort could lead to the development of convenient and nutritious food items that serve as alternative, accessible sources of sustenance. The research was initiated to inspire the residents of Barangay Ponong, Magarao, Camarines Sur—where large plantations of nipa trees exist—to use this resource as a means to enhance the flavor of brownies while maximizing the use of locally available materials. By embracing this innovative concept, the community can unlock new avenues for economic growth, offering additional income streams for its residents. It is crucial for local bakers to cultivate creativity and resourcefulness by incorporating indigenous ingredients like nipa fruit into their recipes, thereby championing local products and harnessing the community's readily available resources. This approach not only promotes economic but also celebrates the unique flavors and heritage of the region.

Foods from Nipa Fruit

Nipa Fruit from the Nipa palm (*Nypa fruticans*) is a cherished local delicacy in Southeast Asia, including the Philippines, known for its unique flavor and substantial nutritional benefits. Rich in essential vitamins, minerals, and antioxidants, Nipa Fruit has long been part of traditional diets, contributing to both the culinary heritage and health of communities. This present study goes beyond traditional uses by utilizing Nipa Fruits to create Nipa Fruit flour, exploring its potential as a nutritious and innovative ingredient in modern baking. By incorporating Nipa Fruit flour into baked goods like brownies, the study not only preserves the cultural significance of this fruit but also introduces it to new markets, showcasing its versatility and health benefits in contemporary food products.

Nipa Fruit, also known as “nipa” or “attap,” is the fruit of nipa palm (*Nypa fruticans*) which primarily grows in mangrove forests. The fruit is commonly consumed in Southeast Asia and is often used in desserts or eaten raw. Nipa fruit contain various vitamins, including vitamin C, which is essential for immune function, collagen synthesis, and wound healing. It likely contains mineral such as potassium which is important for heart health and maintaining fluid balance in the body. Nipa fruit is primarily composed of carbohydrates, providing a source of energy. It may contain dietary fiber, which aids in digestion and helps prevent constipation. Like many fruits, nipa fruit may contain antioxidants which help neutralize harmful free radicals in the body and reduce the risk of chronic diseases. Being a fruit, nipa fruit likely has a high-water content which contributes to hydration (Food security, 2023).

Nipa Fruit, a tropical delight, presents an interesting mix of macro and micronutrients per 100g serving. Predominantly, it carries 22.8 grams of net carbs and 25.2 grams of carbohydrates, which are energy-giving nutrients. It also provides a modest amount of dietary fiber at 2.4 grams, aiding digestive health. This fruit is low in fats (0.6 grams) and contains a small amount of protein (1.7 grams). It's also a source of hydration with 71.5 grams of water. From a micronutrient viewpoint, it shines in its Potassium content, offering 382.0 milligrams. Potassium is essential for maintaining proper heart and muscle function. It also contains moderate levels of Vitamin C (19.2 milligrams) which is crucial for immune health and collagen synthesis. Other essential nutrients housed in the Nipa Fruit include Magnesium (18.0 milligrams), Calcium (30.0 milli grams) and small amounts of Vitamin A, B6, and Iron. These play roles in bone health, nerve function, and oxygen transport respectively (CastIronKeto, 2023).

Moreover, the study of Nugroho et al. (2020) found many chemical compounds in nipa that can be used as raw materials in a product especially in modern medicines. Based on people's beliefs in several tropical countries, nipa has the potential as herbal medicine to treat fever, gout, kidney stones, energy booster, aid digestion, as a cure for certain chronic diseases and metabolic syndromes such as diabetes and hypertension, treat asthma, leprosy, tuberculosis, sick throat, liver disease, snakebite, as a pain reliever, and also used as a sedative that expels excess wind in the body. Then in pharmacological aspect, nipa has antioxidant, antidiabetic, antimicrobial (antifungal and antibacterial), anticancer, anti-inflammatory, antinociceptive, antihyperglycemic and analgesic activities.

Based on Braganza (2023), nipa fruit also a powerhouse of nutrition. Nipa fruit is low in calories, making it an excellent choice for those watching their weight. It contains only about 68 calories per 100 grams. In terms of carbohydrates, Nipa fruit provides around 16 grams per serving. The energy rich macronutrients can fuel your body and keep you going throughout the day. When it comes to fiber content, Nipa fruit doesn't disappoint either. With approximately 2 grams of dietary fiber per serving, it promotes healthy digestion and helps prevent constipation. Furthermore, this tropical fruit is rich in vitamins such as vitamin C and thiamin. These vitamins play essential roles in maintaining the overall health and support various bodily functions. Nipa fruit also contains minerals like potassium and calcium that are vital for proper muscle function and bone health respectively. Additionally, this amazing fruit offers antioxidants that help protect against cell damage caused by harmful free radicals in the body.

Moreover, the study of Tai et al. (2019) *Nypa fruticans* sap (NFS) suggested that replacing table sugar with concentrated NFS up to 20% in carrot cake formulation could effectively enhance its nutritional profile while maintaining desirable physical and sensorial qualities. This finding highlights the potential of NFS as a novel natural sweetener in bakery products, offering both nutritional benefits and consumer acceptability.

Likewise, a recent study of Aziz et al. (2015), revealed that nipa produces considerable amount of fruit with high content of carbohydrate. The mesocarp of the mature fruit is an underutilized potential source of energy. Study reports on the production of flour from the mature fruit mesocarp. Mesocarp processing produced flour with low fat content (1.45%) and high crude fiber content (17.68%). It exhibited low swelling power and solubility. It is similar to the present study of processing nipa fruit flour and the researcher used matured nipa because the characteristics of matured nipa fruit is that, it has a low water content.

In the study of Saithong et al. (2019), it showed that nipa produces considerable amount of fruit with high content of carbohydrate. The mesocarp of the mature fruit is an underutilized potential source of energy. The study evaluated the production of flour from the mesocarp of mature nipa fruit and determined its functional properties. Mesocarp processing produced flour with low fat content (1.45%) and high crude fiber content (17.68%). The flour exhibited low swelling power and solubility, with highest swelling power and solubility achieved at 85 degrees Celsius with value of 4.5 grams per gram and 10.56%, respectively.

As explained by Subiandono et al. (2016), niipa fruits have been used as foodstuffs, such as nipa sugar produced from fresh fruit bunches and salt from old midribs. Nipa fruit endosperm flour (NFEF) contains high carbohydrates (72-88%), high fibers (0.18-22%), low lipids (0.08-12%), and low proteins (2-12%).

Furthermore, the study of Supaking (2019), indicated that an unripe nipa endosperm is popularly consumed as fruit or food. The study aimed to use five different appropriate ratios of unripe and ripe palm on nipa fruit toffee product. Moisture content 3.50%, carbohydrate 85.72%, crude protein 7.43%, total fat 2.86%, ash 0.49% and dietary fiber 4.45% found in the unripe nipa fruit. Therefore, the optimum formula used of nipa fruit toffee consisted of 500

grams of unripe nipa fruit. 500 grams of ripe nipa fruit, 297.50 grams sugar, 352.50 grams of glucose syrup, 150 grams of skim milk and 80 grams of salted butter.

On the other hand, the study of Chau Sum et al. (2014), investigated the nutritional composition of ripe and unripe flesh of *Nypa fruticans*. They determined that the moisture content of ripe flesh was lower than unripe flesh, indicating potential differences in susceptibility to microbial contamination. Ripe flesh had higher carbohydrate and protein content compared to unripe flesh, with protein content notably higher than coconut and other local fruits. Ripe flesh also contained more fat than unripe flesh, although both had much lower fat content compared to coconut. Ripe flesh exhibited high insoluble and soluble fiber content, making up a significant portion of the fruit's nutrient composition, while unripe flesh had lower fiber content. Ripe flesh also had a higher ash content than unripe flesh, indicating richer mineral content, particularly potassium and magnesium.

Agams et al. (2016), obtained the best composition of nutritional value of the flour produced from different ripeness of nipa palm fruit. They used a completely randomized design with three treatments and five replications. Based on the results of physical and chemical analysis, trial no 2 which used Nipa palm fruit with ripeness level of a bit old was selected as the best treatment with moisture content of 13.57%, ash 2.22%, fat 0.06%, protein 6.39%, fiber 20.19%, starch content 61.53% and flour with natural white color.

Moreover, according to Ulyarti et al. (2017), the composition of carbohydrates, protein, fat, and ash in nipa palm mesocarp varied based on factors like growth location and fruit maturity. While young fruit had high water content, mature fruit had significant carbohydrate content and low levels of fat and protein. The chemical composition suggested suitability for flour processing, with previous uses including as an extender in bread processing and biscuit production. Research indicated that biscuits made with a blend of nipa flour and wheat flour had comparable nutritional value to those made solely with wheat flour. This suggests potential applications of nipa flour beyond biscuits, contingent on understanding its functional properties.

Based on Khairi et al. (2020), nipa fruit contains high carbohydrates and protein. Some traced elements and minerals contained in nipa fruit are high, including sodium, magnesium and potassium. Nipa leaves and fruit extracts have pharmacological activities such as anti-inflammatory, anticancer and antihyperglycemic. The benefits in palm leaves and fruit could be developed into functional food and pharmaceutical products.

According to the study of Aulia et al. (2021), Nipa grown in coastal areas has a reasonably high starch content, potentially a source of resistant starch that a beneficial colon microbiota can ferment. Nipa is a potential source of new resistant starch that can be used in diabetes and modulation of normal microflora of the body. The nipa fruit flour obtains a high enough starch content, which is 35.66% which is a potential source of resistant starch. Resistant

starch itself is not absorbed by small intestine. The unprocessed form of resistant starch remains intact in the intestine and will be fermented by good beneficial bacteria such as Bifidobacteria and Lactobacilli.

On the other hand, Nawar et al. (2022), revealed that *Nypa fruticosa*, selected as one of the mangroves, has a potential of nutrition was performed with various parameters such as protein, water content, total sugar, reducing sugar, non-reducing sugar and ash content. The study showed that mangrove fruit has a good prospective value for antioxidants and nutrients and is an alternative food source too for coastal communities. As explained by Hidayat et al (2015), edible mangrove fruit is a natural source of antioxidants, example, the *Nypa fruticosa* was found to produced high yields of sugar saps and it was fermented to be ethanol in high yields, also as competitive as sugarcane and cone, based on the development of natural potential. The flour from nipa fruit had low fat content and high crude fiber content and promising substitute for ordinary flours such as wheat rice especially for producing high fiber food.

The study of Rozi et al. (2022), determined the yield and ripeness level of Nipa fruit with high antioxidant activity. The yield of old nipa fruit palm was higher than young nipa fruit pulp, 15.26% and 9.8% respectively, the antioxidant activity of old nipa palm juice was in the high category. Antioxidants in old Nipa Fruit were found better than in young Nipa fruit.

Similar with the study of Yadav et al. (2016), natural antioxidant is used as an exogenous antioxidant in food system. As explained by Iqbal et al (2017), many natural antioxidants come from various parts such as fruits, root, flowers and even stems.

Further, the study of Zhang et al. (2015), revealed that food antioxidants that exist in food products, both added, and which are naturally present in these foods have many health benefits, including smooth bowel movements, prevent constipation, so as to reduce the risk of cancer, heart disease and reduce cholesterol levels in the blood. One of the local products that has a potential to be functional food as a source of food fiber and natural antioxidants is the fruit of the nipa plant (*Nypa Fruticosa*).

Furthermore, the study of Jeong et al. (2022), found that *Nypa fruticosa* has antioxidant, antidiabetic, and hepatoprotective activities. Plants containing phenolic compounds exhibit anti-cancer and antioxidant activities in humans. Inflammatory responses serve in the immune defense system against stimuli such as infectious agent invasion or endotoxin exposure resulting in the retrieval of normal cell function and structure.

In the study of Hermanto et al. (2019), it showed that Nipa fruit is known to be beneficial as food that has many benefits, especially as a source of food fiber and natural antioxidants. Even until now, this fruit is still not familiar as food natural antioxidant source due to the lack of scientific research.

According to Khanal (2023), Nipa fruit has a white and sweet mesocarp which is the inner content of the fruit. Furthermore, the fruit also provides nutrients like Vitamin C, Potassium, Magnesium, and fibers. Besides, it also serves medicinal properties and is helpful in curing gastrointestinal disorders. Nipa fruits are nutritious that have a variety of benefits. They help prevent excessive sugar intake in the blood. Cardio-health includes improving heart health and regulating blood pressure. It boosts immunity to defend from diseases. Besides, with anticancer properties, the nipa fruit strengthens to fight cancer-causing radicals in our bodies.

Based on Surhaini et al. (2017), young fruit contains considerable amount of water (up to 80%) and this decreases as maturity of fruit increases. The matured fruit contains considerable amount of carbohydrates (51.89%) and very low-fat content (0.48% to 1.16%) and low content (0.7% to 2.4 %). The study focused on the effect of sugar and agar-agar concentration on the chemical and sensory properties of nipa fruit slice jam.

The nutrient composition of the flesh of *Nypa fruticans* has been studied widely. The nutrient composition, especially proximate nutrient contents of the flesh, has previously been reported. The ripe flesh of *Nypa fruticans* fruit can be a good source of macro-nutrients, especially fiber. The unripe flesh of *Nypa fruticans* fruit had higher total phenolics than the ripe fruit that can be used as an alternative source of antioxidants. Due to the high nutritional quality of both ripe and unripe flesh of *Nypa fruticans*, the flesh of *Nypa fruticans* fruit could be served as a raw ingredient for various food uses in the future. Furthermore, investigations have shown that the unripe flesh of *Nypa fruticans* fruit contains higher levels of total phenolics compared to the ripe fruit.

Process of the Nipa Fruit and Best Formulation

Nipa fruit flour is derived from the *Nypa fruticans* palm tree, commonly known as the nipa palm or mangrove palm. The process of making nipa fruit flour involves several steps: Collecting, sorting, cleaning, peeling, grating, drying, pulverizing, and packaging. Nipa fruit flour is gaining popularity as a gluten-free alternative to traditional flours and can be used in a variety of culinary application, including baking, cooking, and as a thickening agent in sauces and soups. The procedures may affect the quality of the finished product depending on the proportion of Nipa fruit flour used in baking a brownies. Through observation and the process, it may easily achieve the best proportion.

The oldest techniques of manufacturing flour in history were to grind the grains between stones. Other methods included the saddles tone (a cylindrical stone that was rolled against grains held in a stone bowl), the quern (a disk-shaped horizontal stone that spun on top of grains held on another horizontal stone), and the mortar and pestle (a stone club striking grains held in a stone bowl). These methods can be attained by the use of one's hands.

Then the millstone was developed, it is a vertical disk-formed stone disk that would roll over the grains that were sitting on another horizontal stone, shaped in the form of a disk as well. The millstone was handled by humans or

animal power. The Romans were a little bit wiser and begun to use waterwheels to power the millstones. In Europe, in the twelfth century, windmills were used to power the millstones (Goodmills Group, 2023).

Moreover, Grain Feed and Milling Magazine (2022), stated that flour is an essential ingredient for making bread and other baked goods like brownie. It is a fine powder of different varieties of grains. Various types of flour are being sold in the market. Nowadays, the process of producing flour has different stages. First, is securing that the grain is clean by removing and separating dirt. Next, it should be washed with water to remove the outer layer (bran). Then, it is ready for grinding and lastly it is where the wheat grains are rolled, broken, and rolled during milling process to get a powdered form or substance. Milling is the separation of the bran and germ from the endosperm, and it is performed through grinding. The quality of the wheat determines the type(s) of flour to be produced (Food Source Information, 2023).

However, Nipa and Mondal (2021), stated that drying as the oldest method for processing and preservation of freshly harvested agricultural produce has long been practiced by human and the quality of the finished product greatly depends on it. The purpose of drying is to reduce the moisture content in a certain level to prevent the microbial deterioration and most of the chemical reactions within the food components.

Meanwhile, Nofiani (2020), investigated the potential of old nipa fruit endosperms to produce flour and cookies. The study aimed to characterize the functional properties of unbleached and bleached old nipa fruit endosperm flour and evaluate consumer acceptability of both the flour and gluten-free cookies made from it. The endosperms were processed into flour through cutting, drying, grinding, and sieving. The unbleached flour underwent bleaching using sodium metabisulfite, followed by drying and sieving to obtain bleached flour. Both flour types were analyzed for functional properties such as bulk density, swelling power, solubility, swelling capacity, water absorption index, and viscosity. Additionally, they were used in the production of gluten-free cookies for consumer assessment.

Nofiani (2020), old nipa fruit or matured nipa fruit contains high carbohydrates that have a potency to be applied to make flour. Next step was peeling, the process of removing the outer covering of nipa fruit using a bolo.

However, Radam et al. (2021), conducted a study to assess the ratio of filled nipa fruit and determine the Rendement of flour obtained from ripe and filled nipa fruit. The process involved removing the fruits from the bunch, sorting them based on content, and counting them. Filled fruits were halved, and the endosperm was extracted, grated, and dried in sunlight for three days before being pounded. The resulting flour was filtered, sun-dried for two more days, and weighed. Key data included the number of filled and empty fruits per bunch, endosperm weight, and flour weight. Similar to the present study, sun drying was used to dry the grated nipa fruit, with the main difference being the duration of drying, which was shorter in Radam's study, lasting only 1 to 2 hours.

The study of Nazarudin et al. (2017), dealt with the production of flour from mesocarp of mature nipa fruit and determined the functional properties of nipa flour. The mesocarp was ground into flour, the epidemics of mesocarp were removed using knives and mesocarp was washed. The clean mesocarp was divided into 12 portions, each was blanched using steam blanching at 100 degrees Celsius for 15 minutes. There were 3 repetitions for each length of blanching. Blanched mesocarp were cut into small pieces and dried in the air oven at 60 degrees Celsius for 6 hours. Dried mesocarp were ground using grinder, sieved using 60 mesh sieves, sealed packaged and kept at room temperature until further used.

Furthermore, Tabinas (2017), focused on the characterization of oil extracted from matured meat of *Nypa fruticans* (nipa plant) nuts. These nuts typically contain edible meat, particularly those found along the central portion of the cluster. The meat, which is oblong-shaped, can be processed as preserved fruit or eaten raw. In this study, only matured nuts were utilized. The extracted oil underwent chemical analysis to assess its physical and chemical properties, which were then compared with those of other known oils. The study aimed to provide insights into the physical and chemical characteristics of nipa oil, potentially offering valuable information for various applications.

Moreover, in the study of Prasad et al. (2020), preparations of nipa fruit extract using with a minor change. The endosperm of nipa fruit (150 gram) dried in an oven at 60 degrees Celsius (constant temperature) until constant weight obtained. The dried nipa fruit was crushed by food processor to make it powder size and sieved at 20 mesh particle size to make uniform powder.

According to Tabinas (2016), Nipa oil is unknown to chemistry handbooks. Due to lack of study on nipa nut oil, it became the subject of this study. The study aimed to characterize and approximate the glyceride composition of the oil extracted from matured nipa nuts. Nipa oil was extracted using Soxhlet apparatus. The sample was prepared by breaking or chopping the nuts into halves. The matured meat was taken out from the shell, hand grated, and oven dried at 105-110 degrees Celsius for 12 hours. The sample was ground manually into fine powder and stored in desiccator ripe nipa flesh is separated from the fruit skin and then cleaned and washed with running water. Nipa is thinly sliced and then oven for 6 hours at 60 degrees Celsius. After drying it is then crushed using a grinder and sieved with a 60-mesh sieve to become a nipa flour.

In the study of Murysyid et al. (2018), ripe nipa flesh is separated from the skin and then cleaned and wash with running water. Nipa is thinly sliced and then oven for 6 hours at 60 degrees Celsius. After drying it is then crushed using a grinder and sieved with a 60-mesh sieve to become a nipa flour. The purpose of the research to determine the effect substitution of wheat flour with nipa flour to Butter Cake characteristics and acceptance of organoleptic test and to obtain the best formulation of nipa flour.

In addition, in their study, Wijana et al. (2023), characterize the galactomannan extracted from Nipa fruit and compare extraction methods using both fresh and dried fruit. Aqueous extraction followed by precipitation with ethanol was utilized, with fresh nipa fruit aged around four months as the main material. The yield of nipa gum extracted from fresh and dried fruits did not significantly differ. However, the source of the fruit significantly impacted properties such as solubility, whiteness degree, water-holding capacity (WHC), and viscosity at various concentrations. Although solubility and oil holding capacity (OHC) were not significantly affected by the extraction source, other properties were. The study concluded that drying could be employed as a pre-treatment method for nipa fruit to minimize damage before processing it into galactomannan.

Based on the study of De Castro (2018), due to emerging technologies, the improvisation of products is a new trend. Spray drying is a new technology that transforms a product in liquid phase into a dry particulate powder. The study aimed to produce and evaluate spray-dried nipa vinegar in three formulations in terms of the physicochemical properties and quality attributes prior to the set process schedule. To describe and compare the quality attributes in terms of taste and aroma of the three formulations. The difference of this study to the present study the researcher used natural way of drying method of nipa flour, which is sun drying method.

In the study of Krairuch et al. (2016), Nipa fruit stalks develop a Vinegar drink from nipa sap, the process of making a vinegar, firstly nipa sap or juice obtained from the fruit stalks of nipa palm was fermented into vinegar. Then 4 prototyped formulation of vinegar drink were developed by mixing the vinegar with nipa sap, butterfly pea extract, roselle-jujube (Chinese's date) juice, and gac fruit juice. They also used Honey for sweetener.

However, the study of Pojchananaphasiri and Lertworasirikul (2017), revealed that the process of Nipa palm fruit was shelled off before used, and then was rinsed in water and then dried. Their research aimed to develop osmotic dehydrated (OD) nipa palm fruit, study mass transfer and develop regression models for quality prediction of dried OD nipa palm fruit during the OD and drying processes. During the OD, when the immersion time increased, the moisture content (MC) of OD nipa palm fruit was decreased, while solid gain (SG) and water loss (WL) were increased. The OD nipa palm fruit was dried in a hot air oven at 50, 60 and 70 degrees Celsius for 240 minutes. The effects of SG and drying temperature on the qualities of OD nipa palm fruit were studied. The results showed that the drying time was in the range of 180-240 minutes so that the MC and water activity (aw) were lower than 18% and 0.75, respectively.

Nipa Palm sugar, a natural sweetener with low glycemic index, is produced from the sap of nipa palm (*Nypa Fruticans*), commonly used in Philippines as roofing materials for bahay kubo or processed as vinegar (sukang paombong) or wine (laksoy). In processing the nipa sugar, they used a mechanical dryer with a built-in thermometer was also acquired. This helped reduce the moisture content from 10 to 2 percent and has resulted to a better taste.

Aside from better taste, the nipa palm produced is also of lighter color and has better texture compared to coco sugar (Foundation for Rural Enterprise and Ecology Development of Mindanao, 2021).

According to Angeles (2018), “Siling Labuyo (*Capsicum Frutescense*) flavored Cakes and Cookies”, the study was also focused on using siling labuyo as flavoring in cakes and cookies and it also undergo drying process. Drying of chili Pepper or Siling Labuyo was the same with steps used in drying the Nipa fruit before pulverizing. It is placed under the heat of the sun at least 4 hours. Sun drying was the main process, but dehydrator can be alternative if the sun is not around. After drying it should be stored in an airtight container to prolong its shelf-life. This study is similar to the present study the researcher applied same method of processing the flour they undergo sun drying and it pulverize to get the fine texture of flour, they only difference used of raw material.

The study of Hade (2023), produced eggplant (*Solanum melongena*) Flour as an alternative ingredient in making pasta noodles. The process involved in making an eggplant flour they sliced thinly and arranged in trays for quick drying. Same procedure in making a Nipa Flour the researcher used sun drying method and pulverizing of dried eggplant to produce a powdery and fine texture and stored in an airtight jar or container to avoid contamination and prong the shelf life.

Based on the study of Francisco (2019), the different processes involved in producing pili pulp flour was gathering, washing, drying, peeling, and sifting. The pili pulp flour was subjected to determine the nutritive value and evaluated the acceptability of different delicacies and baked products produced. This process is used in the present study in preparation of Nipa flour in baked products like brownies.

Similarly, the study of Pardiñas (2018), utilized pili pulp as one of the ingredients in making fish jerky. It underwent different processes like blanching, peeling and dehydrating. Similar to the present study they dehydrate the nipa fruit to prolong the self-life of the material and to get the good characteristics of nipa fruit flour.

Level of Acceptability of Innovative Products

The acceptability of nipa fruit flour in brownies would likely vary among individuals and communities in terms of factors such as color, taste, aroma, texture, and appearance. The nutritional value, cultural perceptions, accessibility and experimental appeal would all play a role in determining how acceptable it is. Ultimately, it would depend on personal preferences and willingness to try new ingredients in baking.

Gungob et al. (2016), conducted a study that identified the optimal mixture for creating desserts using Nipa Fruit. They found that combining 200 grams of desiccated Nipa Fruit with 300 ml of condensed milk produced the best results in terms of taste and texture. This particular formula was highly favored for its balance of sweetness and the

unique flavor profile of the Nipa Fruit. The study highlights the potential of Nipa Fruit as a key ingredient in various dessert recipes, emphasizing its versatility and appeal in culinary applications.

However, the study of Afrizal et al. (2017), revealed that the use of Nipa fruit as raw material for making Jam and the sensory test assessment of the chosen jam had a grey-yellow colored, palm aromatic, sweet tasted, unstick textured and the best ratio of fruit flesh of nipa palm and sugar was trial 3 fruit flesh of nipa palm 60% and sugar 40%.

Canet et al. (2021), produced new fillings for pandesal using *Nypa Fruticans* (nipa fruit). The researchers aim to determine the essential aspect of Pan De Sasa include the following terms: Product Description, Ingredients, tools and equipment. Lastly the acceptance of the sensory quality of the product will be assessed with the following criteria: Taste/Flavor, Texture/Mouth feel, Appearance/Color, and Smell/Aroma. Similar to the current study they asses the level of acceptability of nipa fruit flour in bake brownies.

Additionally, Ocampo et al. (2014), conducted a study to improve the quality of nipa wine. Specifically, it was intended to determine what fruit juices that can be added to nipa wine that improve its quality; compare the sample taste, color and aroma; and determine the cost of production of the different samples

In addition, Burce (2016), studied about the plum seed as main Ingredients for coffee, dealt on the utilization and acceptability of “Black Plum Seeds as Main Ingredients for Coffee”. Black plum seeds are one of the typical fruits that are usually eaten while the seed is thrown away unaware of the other use of it and its nutritional content.

However, Fauza et al. (2021), conducted an analysis of steamed brownies and identified a diverse range of flavor attributes within the samples. The brownies were noted for their sweet and bittersweet taste, along with a distinct burnt chocolate flavor that added depth to the overall profile. Additionally, subtle hints of mocha were detected, complementing the presence of salty notes, which balanced the sweetness. The study also found that the use of margarine or butter and milk powder contributed to the richness and smooth texture of the brownies, enhancing their appeal to consumers.

Moreover, Mohammad et al. (2020), the aroma is an important attribute which determine the quality and consumer acceptance of food the aroma that come from cocoa powder, egg, vanilla and butter or margarine are the most important ingredients in making brownies. The color that come from the ingredients of cocoa powder as the most important in the brownies plays a significant role in its characteristics. The butter or margarine serves as a softening function to achieve the soft or moist texture of brownies.

Putri et al. (2015), described brownies as having a rich, sweet flavor with a pronounced chocolate aroma that is immediately noticeable. The brownies are characterized by their dark brown color, which is indicative of the deep chocolate content. In terms of texture, they are soft yet maintain a solid, dense structure, distinguishing them from other baked goods that might be more fluffy or airy. This combination of strong chocolate flavor, appealing color, and firm texture makes these brownies a favorite among those who enjoy indulgent, chocolate-based desserts.

According to Setyani (2017), found that the quantity of flour used in baked brownies significantly impacts their texture. Specifically, as the amount of flour increases, the brownies develop a firmer and denser texture. This change in texture is crucial for achieving the desired consistency, depending on whether a softer or more robust brownie is preferred. Therefore, adjusting the flour content allows for control over the final product's structure, making it an important factor in brownie preparation.

Biao et al. (2020), studied on creating a healthier version of a cookie by replacing of some of the wheat flour with a mushroom flour. The impact of incorporating different levels of powdered mushroom flour on the rheological properties of the cookie dough and the final cookies was therefore determined. Panelists were trained for descriptive analysis for cookies sensory evaluation. Then, they were asked to evaluate the color of cookies first and then to evaluate their mouth feel, texture, and flavor. Freshly made cookies were served on plates with random three-digit codes to prevent any potential bias. The overall acceptability of cookies was calculated from the average values of all above sensory parameters. Panelists rinsed mouth with water between sample evaluations. A nine-point hedonic scale was used for sensory evaluation. In conclusion, our results showed that cookies with acceptable textures and appearances could be produced by replacing up to 15% of wheat flour with mushroom flour.

Similarly, Brito (2019), conducted a study on muffin used four formulations from different alternative flours, such as eggplant flour. The first formulation is using rice flour and the other three formulation used eggplant flour with addition of 5, 10, and 25%. The products were evaluated using color, taste, odor, texture, and overall impression. The 15% flour eggplant flour proved to be a good alternative for use in bakery products that adds nutritional value.

Branco et al. (2017), developed tagliatelle pasta substituting the wheat flour with different concentrations of a green banana mixed pulp and peel flour. The pasta formulations were prepared replacing the wheat flour showed the highest ash content and the best sensory acceptability of all the formulation. It was concluded that it was possible to develop a tagliatelle pasta with satisfactory acceptance replacing the wheat flour by a green banana mixed pulp and peel flour.

Moreover, Beatriz (2019), studied the level of acceptability of *Cocus Nucifera* Cupcake in terms of sensory characteristics and shelf-life. Three different proportions of the recipe were developed and rated by the five groups of respondents. The sensory attributes were employed in evaluating the product. Lastly, the results of the sensory

evaluation show the first trial was the most acceptable proportion and interpreted as highly acceptable. Based on the ocular observation conducted on the shelf-life of the *Cocus Nucifera* cupcakes, it was found that the cupcake last for six (60 days and is fit for human consumption at room temperature.

Also, Castro (2019), studied the level of acceptability of innovative recipes from squash (*Squash candy, Puto de Kalabasa, Nutri-Nuggets Squash, Dynamite Squash Blast, and Pasta de Kalabasa*) in terms of sensory evaluation and shelf-life. Parents, teachers, and students were chosen to determine the acceptability of the innovative recipes from squash. Overall, the level of acceptability of innovative recipes from squash ranged from “acceptable to highly acceptable” in terms of color, taste, aroma, and appearance. On the other hand, shelf-life varies between recipes when at room temperature and refrigerated.

Bantog (2015), developed ice cream utilizing ripe Tiessa and Pili pulp. She applied developmental, descriptive and evaluative method to determine the acceptability of the finished product.

Ramirez (2021), revealed that crust and filling preparations was subjected to organoleptic tests using the 9-point hedonic scale in terms of food attributes by the different panelists that include food experts, students and professors. There were four treatments as to Crust and filling. Results showed that in terms of odor, texture, flavor and general acceptability all the treatments for fillings were rated like very much while for crust the texture and flavor were rated like moderately. Results showed that there is a high significant mean difference on the respondents' group/panelists' perception for crust and filling texture, odor, and flavor but no significant difference on camote pie general acceptability. Nutrition facts of camote pie for 900g content based on 2015 Recommended Energy and Nutrient Intakes (RENI) and the Philippine Dietary Reference Intakes (PDRI) adult requirements of 19 to 29 years old male showed that calories (kilocalories) are 13%, cholesterol (milligrams) is 30%, total carbohydrate is 15% and protein is 8%.

The study of Alano (2023), found that the best composition of candy dragon fruit peel using sensory characteristics of color, aroma, taste, texture and appearance as indicators, was revealed to be trial 3 with a 3.17 average rating. The respondents favored the bright pink color as compared to the light pink color, preferred the sweet aroma and taste, and flavors the slightly soft and chewy texture and can be prepared in the community because of the availability of ingredients, tools and equipment and easy to follow procedures.

The study of Imperial (2014), was about the Tapol variety of Adlay which was formulated into an instant nutrimeal. Product was evaluated as to its sensory characteristics, physico-chemical properties, microbial load and proximate analysis for the acceptable formulation. The result of sensory evaluation revealed that the product was light brown in color with desirable aroma, moderately viscous consistency and perceptible adlay-vegetable flavor. Acceptability was described as very much like by the respondents.

Hananuzzaman et al. (2014), conducted the study about the processed tomato candy using different sugar proportions through the combination of osmotic dehydration and mechanical drying. A sensory evaluation using a 9-point hedonic scale was carried out to check the overall acceptance of the tomato candy. And, out of the three sugar proportions it was found that the best solution is the 40% sugars having the best average score of the panel. Result shows that tomato candy is acceptable.

Hasan et al. (2020), evaluated the nutritional compound, hardness, and organoleptic properties of emergency food in the form of cookies, prepared from Saba banana flour, soy flour, and Moringa flour. The treatment in this research using a single factor, namely different composition of the flour with three variables and three replications. It was also evaluated hedonic sensory test in terms of color, taste, aroma, and texture. The results showed that all treatments fulfill the calorie requirement of emergency food. In terms of hardness, F2(banana flour 15%, soy flour 15%, and Moringa flour 15%) resulted in the hardest texture of cookies but still eatable. Organoleptic test results showed that cookies with the use of 20% banana flour, 20% soybean flour, and 5% moringa flour favored by the panelists.

Augustyn et al. (2021), characterized the chemical and organoleptic properties of yellow sweet potato flakes with the addition of moringa leaf flour and determine the best treatment. Flakes made from yellow sweet potato flour are one of the products with the addition of moringa leaf flour to increase the added value of the two commodities. The organoleptic characteristics of color, taste, aroma, crispness and overall appearance are accepted.

Ewunetu et al. (2023), conducted a study on the physicochemical and sensory evaluation of bread made from composite flours of wheat, carrot, and banana. The research aimed to enhance the nutritional value of bread by incorporating carrot and banana flour into wheat flour. The study found that the sensory scores varied with the increasing addition of carrot and banana flours to wheat flour, but there was no significant difference in the overall acceptability of the bread, except for the control. Consumers generally preferred the bread from a specific blending ratio (60% wheat flour, 20% carrot flour, and 20% banana flour), but bread from composite flours with substitutions for both carrot and banana flours were also well accepted. Overall, the study demonstrated that bread of acceptable quality can be produced from composite flour of wheat, carrot, and banana, which could contribute to increased nutrition and help prevent malnutrition.

Method

The study utilized descriptive, experimental and Research and Development (R & D) methods to meet the objectives or problems of the study. These three-research method were essential in the conduct of this research that add to its validity. Descriptive method was used in describing the finished product's level of acceptability in terms of color, taste, aroma, texture, appearance, shelf life and economic desirability. A score sheet was answered and

analyzed to describe the level of acceptability of the product. In the three trials, experimental method was utilized to display various ingredients proportionality and find the appropriate recipe preferred by the respondents.

Experimental specifically, Nipa fruit to produced flour was subjected for experiment. Three (3) samples using different formulation were prepared to show the different formulation of ingredients used. The method also determined which among the three (3) samples and recipes was acceptable to the respondents. Research and Development was used to developed a new and improved product to meet the demands of the market. It was also used to gather data during the production of nipa fruit flour in baked products like brownies. On its production, try-out or score sheet was given to the respondents for sensory evaluation. The responses gathered were analyzed based on highly acceptable to least acceptable remarks and described the level of acceptability of the finished product. Production was described in terms of best composition and preparation of nipa fruit flour in baked products like brownies.

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Results and Discussion

Nutritive Value of Nipa Fruit

Nipa fruit, scientifically known as *Nypa fruticans*, comes from the nipa palm, a plant native to many Southeast Asian countries, including the Philippines. Historically enjoyed as a local delicacy, the fruit has recently gained attention for its significant nutritional and medicinal properties. Its high carbohydrate content provides a quick energy source, while dietary fiber aids in digestion. The fruit is also rich in vitamins and minerals, including vitamins C and A, potassium, calcium, and magnesium, all of which contribute to various health benefits like immune function enhancement, bone health, heart health, and overall bodily functions. Moreover, antioxidants present in nipa fruit aid in combating oxidative stress and promoting overall health. In addition to its health benefits, the incorporation of nipa fruit into the baking industry—particularly in products like nipa fruit brownies—can serve as a valuable economic tool for local communities, supporting job creation and promoting sustainable agricultural practices. The consumption of nipa fruit has the potential to address various health issues through its nutrient profile. It can act as a natural energy booster, improve heart health, aid in digestion, and strengthen the immune system. Additionally, beyond its nutritional properties, nipa fruit holds medicinal value, potentially helping with chronic conditions like diabetes, hypertension, and metabolic syndromes. The idea of incorporating nipa fruit into food products, such as brownies, aligns with both promoting healthier lifestyles and fostering local economic development.

According to CastIronKeto (2023), as shown in Table 3, 100 grams of raw nipa fruit flour contains notable amounts of carbohydrates (25.2 grams), fiber (2.4 grams), potassium (382 milligrams), and vitamins A and C. These nutrients support vital bodily functions such as energy production, digestive health, immune response, and cardiovascular health Braganza (2023) found that per 100 grams of nipa fruit provides around 68 calories,

offering an energy-rich macronutrient profile to fuel daily activities. Moreover, Khanal (2023) reveals that the fruit has medicinal properties, particularly in preventing gastrointestinal disorders, controlling sugar levels in the blood, and promoting cardiovascular health. Its antioxidant properties further combat oxidative stress, while its potential anticancer compounds protect the body from damage caused by free radicals. Additionally, nipa fruit strengthens the immune system, which is crucial in the fight against diseases, and improves skin condition and heart health by regulating blood pressure.

Table 3
Nutritive Value of Nipa Palm Fruit
in 1 serving

Nutrients Name	CastIronKeto (2023) Amount and unit per 100g
Net Carbs	22.8 g
Carbohydrate,	25.2 g
Fiber	2.4 g
Fats	0.6 g
Protein	1.7 g
Sodium, Na	4.0 mg
Potassium, K	382.0 mg
Magnesium, Mg	18.0 mg
Calcium, Ca	30.0 mg
Vitamin A	2.0 g
Vitamin B-6	0.22 mg
Vitamin C, total ascorbic acid	19.2 mg
Iron, Fe	0.71 mg
Phosphorus, P	21.0 mg
Thiamin	0.08 mg
Riboflavin	0.1 mg
Niacin	0.5 mg
Pantothenic acid	0.14 mg
Calories	68 kcal
Water	71.5 g
Tryptophan	0.01 g
Lysine	0.04 g
Fatty acids, total saturated	0.23 g

In another study by Nugroho et al. (2020), nipa was found to possess various pharmacological properties, including antioxidant, antidiabetic, antimicrobial, and anticancer activities. The chemical compounds found in nipa have the potential to be used in modern medicines, treating conditions such as diabetes, hypertension, tuberculosis, and liver disease. Traditional medicine in tropical countries also considers nipa fruit an effective remedy for fevers, digestive issues, kidney stones, and metabolic syndromes.

The nutritional and medicinal properties of nipa fruit provide a strong foundation for its used as an alternative ingredient in baking, particularly in developing healthier brownie options. This innovation, supported by the Diffusion of Innovation Theory by Rogers, suggests that adopting healthier and more sustainable ingredients like nipa fruit flour in food production could help address unhealthy lifestyle trends and the growing prevalence of diet-related diseases.

Based on the nutritional data and existing studies, incorporating nipa fruit into food products, such as brownies, can offer numerous health benefits, such as energy boosting, digestive support, and improved heart health. Furthermore, the medicinal potential of nipa fruit adds value to its usage in modern health and wellness products. By developing nipa fruit brownies, communities can benefit not only from better health outcomes but also from increased economic opportunities through sustainable food production. This initiative aligns with the need for healthier dietary choices and the empowerment of local agriculture, contributing to both nutritional well-being and economic growth.

Process of Producing Nipa Fruit Flour

The following procedures (Figure 5) were undertaken to achieve the desired result: peeling, collecting and sorting, cleaning, grating, drying, pulverizing, and finally, storing or packaging. This section discusses these procedures in detail, highlighting their importance in producing Nipa fruit flour.

The process of producing Nipa fruit flour involves multiple steps that contribute to the final quality and usability of the product. Each stage plays a crucial role in ensuring that the Nipa fruit is properly prepared for consumption and for use in baking. The collection and sorting of mature fruits ensure the use of the most suitable ingredients, while steps like drying and pulverizing aim to preserve the fruit's quality and extend its shelf life. The thorough preparation of the fruit reflects established methods from various studies, such as those by Murysyid et al. (2018) and Nipa and Mondal (2021), which demonstrate the effectiveness of washing, drying, and pulverizing in reducing moisture and preventing

The procedures followed in making Nipa fruit flour were methodical and have been optimized for ease of execution and quality control. The first stage, collecting and sorting, focuses on selecting mature fruits, ensuring that only high-quality ingredients are used. The peeling process, which involves removing the outer covering, prepares the

fruit for further processing. Murysyid et al. (2018) supports the step of washing the fruit after peeling, emphasizing the need for Cleanliness to remove any residual dirt or contaminants.

The grating process helps refine the texture of the Nipa fruit, making it suitable for drying. Drying was critical, as it reduces moisture content, preventing spoilage and microbial deterioration. Nipa and Mondal (2021) and Pojchananaphasiri and Lertworasirikul (2017) highlighted the importance of proper drying techniques to extend the shelf-life of fruit-based products. Depending on weather conditions, the researcher either sun-dried the grated Nipa fruit



Figure 5

Procedures in making Nipa Fruit (*Nypa Fruticans*) Flour

for 3 to 4 hours or used a dehydrator for 30 minutes, ensuring flexibility in the process to avoid microbial contamination.

After drying, the next step was pulverizing the fruit into a fine powder using a blender. This transformation into a white, semi-fine flour with a fragrant aroma marks the final product. The last stage, is storing or packaging, ensures that the Nipa fruit flour is kept in a clean, sealed container to prevent contamination and prolong its shelf-life. This step is crucial for maintaining the quality and safety of the product until it is used in baking.

The procedures involved in producing Nipa fruit flour are systematic and effective in transforming raw Nipa fruit into a usable flour form. The meticulous approach of sorting, peeling, cleaning, grating, drying, and pulverizing ensures that the flour produced is of high quality, ready for use in baking. This process not only follows traditional methods but is also supported by scientific studies, as referenced, demonstrating the importance of each step in achieving a desirable outcome. Proper packaging further contributes to the flour's shelf life, making it a practical and sustainable ingredient for various baking applications, including Nipa fruit brownies.

Best Formulation of Nipa Flour in Baking Brownies

The use of alternative ingredients in baking has become a significant focus in recent years, especially with the rise in health-conscious consumers and sustainability efforts. Nipa fruit (*Nypa fruticans*), known for its high starch content, has gained attention as a potential alternative to traditional flour. The primary objective of this study was to explore the best formulation of Nipa fruit flour for making brownies. The researcher conducted three trials with different formulation of Nipa fruit flour and compared the results in terms of the butter mixture's consistency, dough characteristics, and baked product attributes such as color, texture, and overall acceptability.

Nipa fruit Brownies

Formulation 1 (1/2 cup)	Formulation 2 (1 cup)	Formulation 3 (1 1/2 cup)
160 g Melted Butter	160 g Melted Butter	160 g Melted Butter
½ cup Cocoa powder	½ cup Cocoa powder	½ cup Cocoa powder
1 cup Brown sugar	1 cup Brown sugar	1 cup Brown sugar
1/2 cup Nipa Fruit Flour	1 cup Nipa Fruit Flour	1 1/2 cup Nipa Fruit Flour
3 pcs whole eggs	3 pcs whole eggs	3 pcs whole eggs
1 tsp vanilla	1 tsp vanilla	1 tsp vanilla
1 tsp Baking powder	1 tsp Baking powder	1 tsp Baking powder
¼ tsp salt	¼ tsp salt	¼ tsp salt
½ cup chop peanuts	½ cup chop peanuts	½ cup chop peanuts

PROCEDURE

In baking brownies using nipa fruit flour, step-by-step preparation must be followed. First, prepare all the needed ingredients. Then, pre-heat the oven at 170°F. Next, grease the pan 8X8 inch pan with butter and place the parchment paper.

Afterwards, in a mixing bowl, whisk together the 160g melted butter and ½ cup cocoa powder until it creamy then set aside. After that, mix in other mixing bowl the 3 pcs whole eggs and 1 cup Brown sugar beat until light & fluffy.

Then add the butter and cocoa mixture, mix it until well- combined. Add the nipa fruit flour, 1 tsp vanilla, 1 tsp baking powder and ¼ tsp salt. Mix well until all ingredients are combined. Next, pour the butter mixture into prepared baking pan. Sprinkle the ½ cup chop peanut. Finally, bake for 30-35 min at 170 °F and let cool slightly before cutting into bars. Pack the finished baked brownies.

Figure 2

Flow Chart in Making Nipa fruit Brownies

This chart shown the step-by-step procedure in making a Brownies made in Nipa Fruit.

Starch plays a crucial role in baked goods, offering structure, texture, and moisture retention. Studies such as those by Aulia et al. (2021) and Ulyarti et al. (2017) confirmed that Nipa fruit contains 39% starch, which is key to maintaining the moisture and chewiness of the brownies. This study aimed to determine the best formulation for achieving the desired texture, palatability, and overall consumer satisfaction. The illustration of the different formulation of nipa fruit brownies was presented in Appendix H. Table 4 shows the researcher's observation of the three formulations in terms of the characteristics of butter mixture and baked brownies. The researcher performed three trials using different formulation of Nipa fruit flour, each producing distinctive results: Formulation 1

Appendix H

Illustration of the Different Formulation of Nipa fruit (*Nypa Fruticans*) in Brownies

	Nipa fruit flour	Butter	Cooked Brownies
FORMULATION 1		 Creamy and sticky	 Moist and soft
FORMULATION 2		 Slightly creamy	 slightly moist and soft
FORMULATION 3		 Slightly dry	 Soggy, dry, and cracking

Table 4
Comparative Table of the Three Formulations

Quality Attributes	Formulation 1	Formulation 2	Formulation 3
	Characteristics/Observation		
Butter Mixture	Dark Chocolate brown Creamy and sticky	Light Choco brown Slightly Creamy and sticky	Light Choco brown Slightly dry and sticky
Baked Brownies	Moist and soft	Slightly moist and soft	Slightly dry and tough

resulted in a butter mixture that was creamy and sticky. The Baked brownies were moist and soft, with a dark chocolate brown color. This formulation was the most acceptable in terms of texture and flavor. Formulation 2 had a slightly creamy and sticky butter mixture. The baked brownies were slightly moist and soft, with a lighter chocolate brown color. While acceptable, the results were not as desirable as formulation 1. Formulation 3 yielded a slightly dry and sticky butter mixture, leading to brownies that were slightly dry and tough. The color was the lightest among the three, and the texture was less favorable. These findings align with the studies mentioned earlier that emphasize the role of starch in providing structure and retaining moisture in baked goods. In this case, the differences in formulations directly influenced the overall consistency and quality of the brownies.

Through experimentation, the researcher found that Formulation 1 was the best formulation. This trial used a small amount of Nipa fruit flour and resulted in brownies with the most desirable texture—moist, soft, and palatable. This outcome can be attributed to the starch content of Nipa fruit, which helped achieve a balance between moisture retention and structural integrity. Formulation 1 was a dark chocolate color, combined with its chewy texture, was also the most visually appealing, which was a critical factor in consumer satisfaction. As cited in the Theory of New Product Development (Gurbuz, 2018), consumer satisfaction was central to the success of any new product. The experiment's focus on not just physical characteristics but also the sensory qualities of the brownies ensured that the product met consumer expectations.

This study contributes to the growing body of research on the utilization of alternative ingredients in baking and food production. The use of Nipa fruit flour offers potential economic benefits, particularly for communities where Nipa fruit was abundant. The experiment aligns with previous studies on the starch content of Nipa fruit and its role in enhancing the quality of baked products. It also follows the principles outlined in the Theory of New Product Development, which stresses that new product development should account for all aspects of a product, not just its

appearance. Furthermore, this research supports the Sustainable Development Goal (SDG) 2: Zero Hunger, as it explores the potential of a locally sourced and sustainable food ingredient. By experimenting with Nipa fruit flour in brownies, the study opens up possibilities for its broader use in other baked goods, which could benefit both health-conscious consumers and communities looking to create sustainable food systems.

This study determined that Formulation 1 of Nipa fruit flour was the most successful in producing brownies with the ideal texture, color, and overall quality. This formulation demonstrated the importance of starch in maintaining moisture and structure in baked goods. The findings of this research not only provide a new avenue for utilizing Nipa fruit flour in baking but also contribute to sustainable food practices and local economic opportunities.

Level of Acceptability of Nipa Fruit (*Nypa Fruticans*) Brownies

The development of new food products using alternative ingredients can provide healthier, more sustainable options while contributing to local economies. This study explores the acceptability of brownies made with Nipa fruit flour (*Nypa fruticans*) among respondents from Barangay Ponong, Magarao, Camarines Sur. Specifically, the study assessed the sensory attributes—color, taste, aroma, texture, and appearance—of brownies made with three different formulations of Nipa fruit flour. The results of the sensory evaluation shown on Table 5 were analyzed to identify the formulation that yielded the most favorable results in terms of consumer acceptability.

Color. In terms of color, Formulation 1 was rated the highest with an average weighted mean of 3.85, indicating it was highly acceptable among all respondents. Its dark chocolate brown color was preferred, consistent with the findings of Mohammad (2020), which emphasized the importance of cocoa powder in brownies. Formulation 2 scored 3.15, while Formulation 3 scored 2.88 average weighted mean, making them moderately acceptable in terms of color. The use of cocoa powder in Formulation 1 gave it a rich, dark hue that contributed to its higher acceptability.

Taste It was a crucial factor in determining the overall acceptability of food products. Formulation 1 scored 3.25, indicating that it was moderately sweet and slightly bitter, which was preferred by the respondents. Formulation 2 scored 2.88, also being moderately acceptable, while Formulation 3 scored 2.43 average weighted mean making it less favorable. According to Putri et al. (2015), brownies should have a balance of sweetness and a strong chocolate flavor, which was achieved in Formulation 1 due to the balance between Nipa fruit flour and cocoa powder.

Aroma. The aroma plays a key role in food acceptability, as it influences the perception of taste. Formulation 1 achieved an average weighted mean of 3.25, making it moderately acceptable. Formulation 2 scored 3.03, and Formulation 3 scored 2.90 average weighted mean, indicating that the aroma was consistent across all formulations.

but was most appreciated in Formulation 1. The pleasing aroma in all three versions was attributed to ingredients such as cocoa powder, vanilla, and butter, as highlighted by Mohammad et al. (2020).

Texture. The Texture was another significant aspect, especially in baked products like brownies. Formulation 1 had the highest score 3.48 average weighted mean for texture, reflecting a highly acceptable moist and soft consistency that respondents favored. Formulation 2 scored 3.33, and F3 scored 2.90 average weighted mean, making the latter less favorable due to its drier and tougher consistency. The study by Setyani (2017), emphasized that the amount of flour impacts the texture of brownies, which was confirmed in this research were the balance of Nipa fruit flour in Formulation 1 led to a better texture.

Table 5
Acceptability levels of Formulation
in Sensory Characteristics

Quality	Types of Formulation					
	Formulation 1		Formulation 2		Formulation 3	
	WM	Int	WM	Int	WM	Int
Color	3.85	HA	3.15	MA	2.88	MA
Taste	3.25	MA	2.88	MA	2.43	A
Aroma	3.25	MA	3.03	MA	2.90	MA
Texture	3.48	MA	3.33	MA	2.90	MA
Appearance	3.48	MA	3.48	MA	3.23	MA
Overall	3.46	MA	3.17	MA	2.87	MA
Rank	1		2		3	

Legend:

F1 – Formulation 1	3.76 - 4.00	- Highly Acceptable
F2 – Formulation 2	2.51 – 3.75	- Moderately Acceptable
F3 – Formulation 3	1.76 – 2.50	- Less Acceptable
WM – Weighted Mean	1.00 – 1.75	- Least Acceptable
Int - Interpretation		

Appearance. The appearance was crucial as it creates the initial impression of a product. Both Formulation 1 and Formulation 2 were rated equally 3.48 average weighted mean as moderate acceptable in terms of appearance, described as firm and whole. Formulation 3 scored slightly lower 3.23 average weighted mean, but it was still moderately acceptable. The brownies in Formulation 1 and Formulation 2 had a more visually appealing look compared to Formulation 3, which was critical to consumer acceptance, as noted by Lalugan (2015).

As presented and interpreted in Table 5 and Table 6, based on the sensory evaluation results, Formulation 1 emerged as the most

Formula tions	Quality Attributes	Weighted Mean				Average Weighted Mean	I
		A	B	C	D		
F1	Color	3.80	3.70	4.00	3.90	3.85	HA
	Taste	3.10	3.50	3.10	3.30	3.25	MA
	Aroma	3.20	3.20	3.60	2.80	3.25	MA
	Texture	3.30	3.50	3.70	3.40	3.48	HA
	Appearance	3.60	3.70	3.60	3.60	3.48	HA
	Over- All	3.40	3.44	3.60	3.40	OWM 3.46	HA
F2	Color	2.50	3.30	3.00	3.80	3.15	MA
	Taste	2.60	2.80	3.00	3.10	2.88	MA
	Aroma	3.10	3.20	2.80	3.00	3.03	MA
	Texture	3.30	3.50	3.10	3.40	3.33	MA
	Appearance	3.40	3.70	3.10	3.70	3.48	HA
	Over- All	2.98	3.30	3.00	3.40	OWM 3.17	MA
F3	Color	2.30	2.70	2.90	3.60	2.88	MA
	Taste	2.50	2.00	2.30	2.90	2.43	LA
	Aroma	3.00	2.40	2.80	3.40	2.90	MA
	Texture	3.00	2.90	3.10	3.30	2.90	MA
	Appearance	2.70	3.40	3.10	3.70	3.23	MA
	Over- All	2.70	3.30	3.00	3.38	OWM 2.87	MA

acceptable formulation, with a weighted mean of 3.46, followed by Formulation 2 (3.17) and Formulation 3 (2.87). F1 was highly acceptable across all sensory attributes—color, taste, aroma, texture, and appearance—especially in the categories of color and texture, where it outperformed the other formulation.

The findings suggest that the balance of Nipa fruit flour and cocoa powder in Formulation 1 contributed to its success. The dark chocolate color, moist texture, and balanced sweet-bitter taste made formulation 1 the preferred choice among the respondents. The use of Nipa fruit flour, which is neutral in flavor, allowed the cocoa powder, sugar, and butter to shine through, creating a product that was both appealing and palatable to the respondents.

This study highlights the potential of Nipa fruit flour as a viable alternative ingredient in baked goods, aligning with sustainable food practices and local economic development. The findings echo Inayat Ali's Production Theory, which emphasizes converting local resources into valuable products to meet consumer demand and support economic growth (Castro, 2019). By utilizing Nipa fruit, local farmers can tap into a new market, adding value to a naturally abundant resource and contributing to the community's economic well-being. Furthermore, the research supports the Sustainable Development Goal

Table 6
Acceptability levels of Formulation in
Sensory Characteristics

(SDG) 2: Zero Hunger, promoting the use of locally sourced ingredients to create affordable and nutritious food products. The successful incorporation of Nipa fruit flour in brownies demonstrates its potential for broader application in the baking industry, providing an innovative solution that benefits both health-conscious consumers and local producers.

The Formulation (F1) of Nipa fruit brownies proved to be the most acceptable among the three formulations tested, based on the sensory evaluation of respondents from Barangay Ponong, Magarao, Camarines Sur. The high ratings for color, texture, and appearance underscore the potential of Nipa fruit flour as an alternative ingredient in baked goods. By contributing to both local economic development and sustainable food practices, this study opens the door for future research and the expansion of Nipa fruit flour products in the food industry. Formulation 1 of Nipa fruit brownies proved to be the most acceptable among the three formulations tested, based on the sensory evaluation of respondents from Barangay Ponong, Magarao, Camarines Sur. The high ratings for color, texture, and appearance underscore the potential of Nipa fruit flour as an alternative ingredient in baked goods. By contributing to both local economic development and sustainable food practices, this study opens the door for future research and the expansion of Nipa fruit flour products in the food industry.

Shelf-Life of Nipa Brownies through Physical Observation

Identifying the shelf life of Nipa fruit (*Nypa fruticans*) in brownies was crucial for determining the lifespan of the finished product, particularly if it was to be used commercially. Understanding the shelf life allows consumers to identify the expiration date easily and ensures the product remains safe to consume. Shelf-life of Nipa fruit brownies was shown in Figure 9. Shelf life was defined as the period during which the baked product retains acceptable qualities, such as color, taste, aroma, texture, and appearance. In this study, determining the shelf life of Nipa fruit brownies is vital for assessing their commercial viability.

To determine the shelf life, the researcher employed sensory evaluation and ocular observation to monitor the qualities of the brownies made using three different formulation of Nipa fruit flour—Formulation 1, Formulation 2, and Formulation 3. These brownies were observed daily at room temperature, using the researcher's sensory abilities to evaluate the texture, color, appearance, and other sensory attributes. The study tracked how these characteristics changed over time.

The findings revealed that the quality of the brownies remained stable for the first 10 days of storage. Up to the 10th day, the texture, color, and appearance of all three formulation (F1, F2, and F3) remained consistent. However, changes began to manifest on the 11th day, particularly in Formulation 3, where the brownies became slightly dry and showed early signs of mold formation. This suggested that Formulation 3 did not maintain the desired moist texture. By the 12th day, mold began to appear in Formulation 2 as well. By the 14th day, mold was present in all three proportions, indicating that the brownies were no longer safe for consumption.

The findings of this study align with those of Angeles (2018), Hade (2023), and Francisco (2019), who found that drying raw materials, such as fruits and vegetables, extends their shelf life by removing moisture. The drying process preserves the nutrients, concentrates the flavor, and enhances the compactness of the product, making it more convenient and versatile for year-round used. Based on the observations, it was evident that the shelf life of Nipa fruit brownies stored at room temperature was approximately 10 days. After this period, the product's texture begins to degrade, and mold formation starts, making it unsafe for consumption. This information was critical for determining the commercial potential of Nipa fruit brownies and for guiding proper storage recommendations to ensure consumer safety.

Figure 6
Shelf-Life of Nipa Fruit Brownies at Room temperature

Number of Days and Observation	Formulation 1 (F1)	Formulation 2 (F2)	Formulation 3 (F3)
Day 1-10			
Observation	Constant shelf-life and safe for human consumption with quality in terms of sensory attributes.		
Day 11-13			
Observation	F1 were slightly moist. F2 and F3 has already few spots of molds.		
Day 14			
Observation	Increased and visible molds in all three proportions on the 14 th day and on the next succeeding days. F3 contains many molds due to less of moisture content coming from butter. Nipa fruit helps in preserving the shelf-life of the finished product because of less moisture and adds hardness to the brownies.		

Economic Desirability of Brownie made from Nipa Fruit

The economic desirability of a product was crucial in determining its potential success in the market, especially when introducing a new, innovative product. In this study, brownies made from Nipa fruit flour were developed as an alternative to traditional brownies, with an emphasis on promoting sustainable food production and supporting local communities. Evaluating the economic desirability of these brownies is essential to assess whether they were a viable product in terms of affordability, marketability, and profitability. This section explores the various economic factors related to the production, pricing, and market potential of Nipa fruit brownies.

The economic desirability of Nipa fruit brownies was assessed through several key factors. First, the cost of raw materials was found to be low, as Nipa fruit was abundantly available in the local community, which significantly reduces production costs. The production process itself, while straightforward, required an initial investment in labor and equipment to convert the fruit into flour and incorporate it into brownies. However, the novelty of the product boosted its market appeal, particularly among consumers who value sustainability and health-conscious foods. This appeal to eco-conscious markets and those seeking alternatives to traditional sweets increases the potential for profitability. Additionally, the low cost of raw materials, combined with the potential for local production, offers an opportunity for economic empowerment in rural areas, enhancing the product's overall economic desirability.

Based on the evaluation, it was inferred that Nipa fruit brownies offer moderate to high economic desirability. The affordability of Nipa fruit as a raw material, which is locally sourced, reduces production costs, making the product accessible to a broader market. Furthermore, the unique selling point of using a less common, eco-friendly ingredient increases its marketability, catering to consumers who were looking for healthy, sustainable food options. However, the potential success of the product is not solely based on these factors; it also depends on effective marketing, consumer acceptance, and pricing strategies.

The analysis of the economic desirability of Nipa fruit brownies shows that the product can be both profitable and sustainable, given the right market conditions. The low cost of Nipa fruit and its availability in the local area contribute to lower production costs, allowing for competitive pricing in the market. Additionally, the novelty of the product, combined with its health and environmental benefits, increases its potential appeal to a growing segment of consumers looking for innovative and sustainable food options. The challenge lies in scaling production and ensuring consistent quality, but the economic potential remains high, especially in local and eco-conscious markets. Furthermore, the potential for creating local jobs and supporting rural economies adds to the overall economic appeal of the product.

These findings align with previous studies on the economic potential and versatility of Nipa fruit as an ingredient in food production. For instance, Gungob et al. (2016) discovered that a mixture of 200 grams of desiccated Nipa fruit with 300 ml of condensed milk produced the best formula for making desserts. This highlights the flexibility of Nipa fruit as a key ingredient in sweet products, similar to its role in brownies. The high sensory acceptability of their product demonstrates Nipa fruit's potential in the commercial market, aligning with the high marketability of Nipa fruit brownies. Furthermore, Afrizal et al. (2017) demonstrated the use of Nipa fruit as a raw material for jam production, noting that the best ratio of fruit to sugar was 60% fruit flesh to 40% sugar. Their findings on the sensory attributes of Nipa fruit jam—particularly its color, aroma, and texture—underscore the potential of Nipa fruit as a key ingredient for various processed food products. These results echo the sensory appeal and acceptability of Nipa fruit brownies. Similarly, Nofiani (2020), explored the potential of old Nipa fruit endosperms for flour production, revealing that Nipa fruit flour could be successfully applied to gluten-free cookies. The study underscored the versatility of Nipa fruit flour, a finding that complements the successful use of Nipa fruit flour in brownies, as explored in this research. The high consumer acceptability of Nipa fruit flour-based products further supports its economic desirability for new product development. Moreover, Murysyid et al. (2018), examined the substitution of wheat flour with Nipa fruit flour in butter cakes, revealing that Nipa fruit flour can positively influence product characteristics while maintaining sensory acceptability. This finding was particularly relevant to the current study, which evaluates the economic desirability of using Nipa fruit flour in brownies, both as a novel ingredient and as a potential income source for local communities. Lastly, the study by FREEDOM (2021) demonstrated the commercial potential of Nipa fruit by producing and selling Nipa fruit sugar in the market. This successful commercialization of a Nipa fruit-based product supports the broader market potential for Nipa fruit brownies, reinforcing the product's economic desirability.

Conclusions

The study concluded that Nipa fruit (*Nypa fruticans*) contains essential nutrients that contribute to better health, making its incorporation into brownies a beneficial alternative for guilt-free consumption. The production of Nipa fruit flour follows specific procedures, and adhering to them correctly ensures efficiency and high-quality output. Among the tested formulations, Proportion 1, which contained a smaller amount of Nipa fruit flour, was found to be the most suitable due to its ability to produce soft and moist brownies. All three formulations were moderately acceptable in terms of sensory attributes such as taste, aroma, texture, and appearance, while the color of Proportion 1 was rated highly acceptable. Additionally, the study found that Nipa fruit brownies have a shelf life of approximately 10 days at room temperature, after which changes in texture, appearance, and mold growth make them unsuitable for consumption. These findings provide valuable insights for commercial production and consumer awareness regarding the quality and expiration of Nipa fruit brownies.

Recommendations

Future researchers are encouraged to explore other sources of the nutritive value of Nipa fruit and compare their benefits using different cooking methods. In producing Nipa fruit flour, using a blender instead of grating can result in a finer texture. After blending, the flour can be dried in a dehydrator and then ground in a rice mill for a smoother consistency. Researchers may also modify or add ingredients to enhance the texture, appearance, and palatability of Nipa fruit brownies. While all proportions tested in the study were moderately acceptable to respondents, continuous research and development are recommended to achieve a highly acceptable product. Future studies can utilize the finished product and experiment with different brownie recipes to improve taste and commercial viability. Proper preparation, appropriate ingredient selection, and effective storage or packaging can help extend the brownies' shelf-life. Based on the findings, storing Nipa fruit brownies in a controlled environment is recommended to maintain their quality, while packaging methods that prevent moisture and microbial growth should be considered to extend viability. Further research on additives or preservatives is also suggested to prolong shelf-life without compromising sensory attributes. Additionally, conducting a microbial test on Nipa fruit brownies is recommended to ensure food safety and quality.

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