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Sweet Potato (*Ipomoea batatas*) and Malunggay (*Moringa Oleifera*) Cupcake as an Alternative Healthy Snacks

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Abstract

This study produced sweet potato (*Ipomoea batatas*) and malunggay (*Moringa Oleifera*) Cupcake as an alternative healthy snack. The specific problems answered were: (1) to identify the nutritive value of sweet potato (*Ipomoea batatas*) and malunggay (*Moringa Oleifera*); (2) to determine the process involved in producing sweet potato flour and malunggay powder; (3) to identify the best formulation in making Cupcake; (4) to determine the level of acceptability of the Cupcake; (5) to determine the shelf-life of the Cupcake; and (6) to determine the economic desirability of sweet potato and malunggay Cupcake.

The respondents of this study, were children, students, parents, and teachers in barangay Ponong, Magarao, Camarines Sur. The study used descriptive and research and development method to achieve the specific objectives. A survey questionnaire was used to collect the data. Data were analyzed using a weighted mean in carrying out the statistical treatment of this study. Appropriately, this was used to determine the level of acceptability of the Cupcake and best formulation in making the Cupcake using sweet potato and malunggay.

The findings revealed that: (1) sweet potato contain proteins, carbohydrates, fiber, and different vitamins and minerals. Malunggay contain energy, protein, carbohydrates, fat, fiber, Vitamin C, Beta-carotene, iron, calcium, and phosphorus; (2) the processes to produce sweet potato flour involves collecting and sorting, washing and cleaning, peeling, shredding, sun-drying, pulverizing, sieving, and storing while, malunggay powder production involves collecting and sorting, leaves removal from the stalk, arranging on a tray, oven-drying, pulverizing, sieving, and storing; (3) the study experimented with three formulations in producing a Cupcake and Formulation 3 was found to be the best that obtained (3.29) in terms of firmness, uniformity, appearance, and taste; (4) in the level of acceptability, F3 got the highest average weighted mean of 3.29, followed by F2 that obtained an average weighted mean of 3.23 and F1 got an average weighted mean of 2.69; (5) the shelf-life of all the three formulations lasted up to four days for safe human consumption at room temperature; (6) the Cupcake produced

from sweet potato and malunggay has its economic desirability. Converting the raw materials to sweet potato flour and malunggay powder served as the main ingredients in producing a Cupcakes that benefited the community by consuming healthy snack. Additionally, it also served as an alternative source of income of entrepreneurs in the community and job opportunities.

This study concluded that: (1) sweet potato and malunggay contain essential nutrients that nourish the body to become healthy. Thus, consuming sweet potato and malunggay Cupcake help to improve one's health and prevent from various diseases; (2) there were specific procedures to be followed in producing sweet potato (*Ipomoea batatas*) flour and malunggay (*Moringa Oleifera*) powder; (3) the best formulation of the Cupcake, using sweet potato flour and malunggay powder as an alternative main ingredient was Formulation 3 with equal parts of sweet potato flour and all-purpose flour. (4) All of the three formulations were moderately acceptable up to highly acceptable to the respondents in terms of sensory attributes: color, taste, aroma, texture, and appearance. (5) The shelf-life of the three formulations of Cupcake lasted for four days while inside an airtight container in room temperature for safe human consumption; (6) Cupcake produced from sweet potato and malunggay has its economic desirability by converting the raw materials into sweet potato flour and malunggay powder. Consuming the Cupcakes as an alternative healthy benefited the community. Additionally, Cupcakes can serve as an alternative source of income for entrepreneurs in the community and job opportunities.

Keywords: sweet potato (Ipomoea batatas), malunggay (Moringa Oleifera), cupcake,alternative healthy snacks

Introduction

In a world where fast food and processed snacks dominate the market, it's essential to take a step back and focus on nutrition and health. A healthy food intake of an individual provides good health, healthy mind, and helps protect the body from various diseases. Choosing healthy food and snacks today needs to be considered. There were raw materials that were abundant and constantly available in our area that need to be developed and produced to be useful for the community.

In the current era of increasing health awareness, there was a significant shift towards the development of healthier snack alternatives that cater to both nutritional needs and taste preferences. One promising candidate in this domain is the Sweet Potato (*Ipomoea batatas*), a versatile and nutrient-rich root crops. Sweet Potatoes are lauded for their impressive nutritional profile, which includes high levels of beta-carotene, vitamins C and E, dietary fiber, potassium, and antioxidants. These nutrients contribute to various health benefits, such as improved vision, enhanced immune function, better digestive health, and reduced risk of chronic diseases. Moreover, the complex carbohydrates in Sweet potatoes provide a steady release of energy, making an ideal component for snacks aimed at sustaining energy levels throughout the day. Additionally, malunggay leaves are known for their rich content of vitamins, minerals, and antioxidants. They were particularly high in vitamins A, C, and E, calcium, potassium, and protein, as well as a wide array of phytonutrients that exhibit potent antioxidant properties. These nutrients contribute to various health benefits, including enhanced immune function, improved bone health, better vision,

and reduced oxidative stress. Furthermore, the bioactive compounds in malunggay leaves have been linked to anti-inflammatory, anti-diabetic, and cholesterol-lowering effects, making them an ideal candidate for health-promoting snacks.

In the pursuit of healthier dietary habits, the need for nutritious and appealing snack options has never been more critical. Traditional snacks often contain high levels of sugars, unhealthy fats, and artificial additives contributing to various health issues such as obesity, diabetes, and cardiovascular diseases. Cupcakes, typically seen as indulgent treats, have gained attention as a potential medium for introducing healthier ingredients and innovative formulations. By reformulating traditional Cupcake recipes with nutritious ingredients such as sweet potato and malunggay, it is possible to produce a product that not only satisfies sweet cravings but also provides essential vitamins, minerals, fiber, and antioxidants. This approach aligns with the growing consumer trend towards functional foods that support overall health and well-being.

In recent years, the growing awareness of the relationship between diet and health has led to a significant shift in consumer preferences toward healthier eating habits. Snacks, which are an integral part of many people's daily food intake have come under scrutiny due to their traditionally high content of sugars, unhealthy fats, and artificial additives. As a result, there is an increasing demand for healthy snacks that provide nutritional benefits without compromising on taste and convenience. Healthy snacks are designed to offer a balanced mix of essential nutrients such as vitamins, minerals, fiber, and antioxidants, while minimizing unhealthy components like refined sugars and trans fats. These snacks not only help in maintaining energy levels and satiety between meals but also support overall health and well-being.

The malnutrition and hunger that are facing of our community was need a solution. But there were ignored available raw materials and food resources in our community that can be a solution to fight malnutrition and hunger. One way of addressing it was to produce healthy food or snacks. Relative to this issue, the Sustainable Development Goals (SDGs), also known as the 2030 Agenda for Sustainable Development, were adopted by all United Nations Members States in 2015, highlighted and discussed the 17 goals to target in 2030, and one of these was the sustainability Development Goal 2 or known as ‘zero hunger’.

> *Sustainability Development Goal 2 targets by 2030 to end hunger and ensure access by all people, particularly the poor and people in vulnerable situations, including infants, to safe, nutritious, and sufficient food all year round.*

Based on the worldwide issues mentioned, extreme hunger and malnutrition remain huge barriers to the development of many countries. Under nourished and severe food insecurity appear increasingly. Additionally, according to the World Health Organization, malnutrition in all its forms present a significant threat to human health. WHO confirmed the double Burden of Malnutrition (DBM) the world was facing, especially in developing

countries. Similarly, the 8th National Nutrition Survey (Department of Science and Technology-Food and Nutrition Research Institute, 2014) showed that for children aged 5 to 10 years old, 29.1% were underweight, 29. 9% were stunted, 8.6% were wasted, and 9.1% were overweight. The double burden of under and over nutrition experienced by the school children in the Philippines was due to the fact that total intake for some children has remained inadequate, resulting in undernutrition. Unhealthy food eating patterns- more sugars, fats, and oils, and less leafy vegetables and whole grain cereals, and a sedentary lifestyle led to an upward surge in overweight and obesity. For long lasting benefits of prevention and health promotion efforts, it is important to affect change not only in the individual but also at the community level, and schools are recognized as a good avenue for health promotion strategies. In line with above concerns, the Department of Education issued a DepEd Order no. 13 series 2017 entitled "Policy and Guidelines on Healthy Food and Beverage Choices in Schools and in DepEd offices" for the promotion and development of healthy eating habits among the youth and DepEd employees by making available healthy, nutritious, and affordable menu choices, and for setting food standards. Producing food products that raw materials were readily available in the community and educating people about consuming healthy foods can be effective ways to fight malnutrition, hunger, and sustainability.

These were sweet potato and malunggay leaves which can see in most places in Camarines Sur. Malunggay (*Moringa oleifera)* was one of the world's most useful plants. Moringa has been called "The Miracle Tree", "Nature's Pharmacy", "Powerful Vitamin Factory" and "Most nutritious vegetable on the planet", among others. One of the nutritional facts of Moringa is that it has four times the vitamin A of carrots, seven times the vitamin C of oranges, four times the calcium of milk, three times the potassium of bananas, and three-fourth the iron of spinach. Plant parts of Moringa from roots to seeds were used for health and nutritional purposes. A comparative analysis sample is that a cup (eight ounces) of cow's milk or yogurt could supply 300 to 400 mg of calcium which was half of the daily necessary amount. However, one cup (eight ounces) of fresh Moringa leaves contains 1,000 mg of Calcium. Moringa is a healthy food. It is used as a fortification ingredient for 'nutri-buns' and has been used locally as a flavor mix for our favorite `pan-desal'; condiments, cooking oil, food supplements, and vitamins; beverage: tea, coffee, energy drinks, and for snacks ingredients for biscuits, cookies, and bread (Palada, 2022).

Likewise, the Philippines Sweet Potato was the third most important crop after rice and maize (Flores et al., 2018). The agriculture department classifies Sweet Potatoes as a high-value crop and encourages investment and consumption as they are believed to play a major role in food sufficiency. The country's production of sweet potatoes is primarily based in the provinces of Bicol and in Central Visayas regions. In 2019, the records of the Philippine Statistics Authority (PSA) showed that the Bicol Area was the top producer in the country. Nevertheless, given the potential of this variety, the Philippine sweet potato industry was not moving processing development to the farm level. Additionally, the post-harvest system is one of the main issues in sweet potato farming that leads to losses for farmers (Flores et al., (2017).

Given the present public health issues and consumer trends, it was vital that this research study on "Sweet Potato and Malunggay Cupcake as an Alternative Healthy Snack" be conducted. Through utilizing the nutritional potential of sweet potato and malunggay, this research aimed to produce a healthy snack that satisfies consumers' needs for taste and health while also promoting sustainable food production methods. The results of this study may have significant effects on consumer education, food industry innovation, and nutrition for public health, all of which could lead to a society that is healthier and more informed, particularly the children and parents of Ponong, Magarao, Camarines Sur and the students and teachers of Ponong Integrated School.

Other varieties of sweet potato and malunggay were not used in this study. Only the common variety of sweet potato and malunggay found in barangay Ponong, Magarao, Camarines Sur and nearby municipalities. Also, the study did not include the microbial analysis of sweet potato and malunggay Cupcake. Foods from Sweet Potato

Sweet Potato gained popularity in the world particularly in the Philippines because of its nutritional value. It can be planted all year round anywhere in the Philippines, particularly in Camarines Sur. Many varieties of sweet potato will depend on the colors such as white, cream, yellow, purple, and orange. Filipinos consider it a staple food and healthy because of its nutritional value which helps the body's growth and prevents from various diseases. Several studies had provided evidence for the protective effects of sweet potatoes against diseases. Besides, according to United States Department of Agriculture National Agricultural Library (2015), for every 100 grams of raw sweet potato, it contains 86.0 kilocalories energy, 1.6 grams protein, 0.1 grams total lipid fat, 20.1 grams carbohydrates, 3.0 grams fiber, 4.2 grams of sugar, 30 milligrams calcium, 25 milligrams magnesium, 55 milligrams Sodium,2.40 milligrams total ascorbic acid, 0.08 milligrams thiamin, 0.06 milligrams Riboflavin, 0.56 milligrams Niacin, 0.209 *milligrams* Vitamin B-6, 11 micrograms of Dietary Folate Equivalents (µg-DEF) folate, 0.26 *milligrams* Vitamin E, 1.8 *micrograms* (µg) Vitamin K, and 14187 International Unit (IU) of Vitamin A.

Also, Alam (2021), mentioned that sweet potato particularly orange-fleshed is a rich source of β-carotene (pro-vitamin A) and a good source of minerals (magnesium, iron, copper, manganese, calcium, and potassium), vitamins (B1, B6, C, E). Sweet potatoes are an exceptionally essential crop in several parts of the world, being produced in more than 100 countries. It is also a main food crop of the tropical and subtropical areas and therefore provide nutritional advantage to the people of rural and urban regions by enhancing its production and increasing the consumption. Sweet potato positioned the sixth most major food crop in the world, and fifth most essential food crop on a fresh weight basis in developing countries after rice, wheat, maize and cassava.

In the study of Pati et al. (2021), sweet potato is a rich source of vitamin A and potassium. It also provides some calcium, iron, magnesium, and folate. The health benefits of vitamins and minerals present in sweet potato are important in our body. Vitamin C antioxidants may decrease the duration of the common cold and improve skin. Potassium is also important for blood pressure control; this mineral may decrease the risk of heart disease. Vitamin E is a powerful fat-soluble antioxidant that may help protect your body against oxidative damage. Vitamin B6

plays an important role in the conversion of food into energy. Manganese is important for growth, development, and metabolism.

Based on Dahl et al. (2015), people who consumed more dietary fiber have less risk of chronic disease. Higher intakes of dietary fiber reduce the risk of developing several chronic diseases, ncluding cardiovascular disease, type 2 diabetes, and some cancers, and have been associated with lower body weight. The Adequate Intake for fiber is 14 grams total fiber per 1,000 kilocalories, or 25 grams for adult women and 38 grams for adult men, based on research demonstrating protection against coronary heart disease. Properties of dietary fiber, such as fermentability and viscosity, are thought to be important parameters influencing the risk of disease.

Since sweet potato has fiber content El Tayeb et al. (2015), stated that sweet potato plays a favorable role in reducing the blood cholesterol level. Sweet potato has high nutritional value, not only its content of polysaccharides and minerals but also, its vitamin content of carotenes. Orange- fleshed sweet potato (OFSP) varieties rich in βeta-carotene, a precursor of vitamin A is one of the least expensive sources of dietary vitamin A. Sweet potato flour can serve as a source of energy and nutrients (carbohydrates, βeta-carotene and minerals can add natural sweetness, color, flavor and dietary fiber to processed food products.

Accordingly, in the study of Ohizua et al. (2016), paved the way for enhanced utilization of cooking bananas, pigeon peas, and sweet potatoes. The study revealed that cooking banana, pigeon pea, and sweet potato flour blends were good sources of protein, fiber, and carotenoids and are desirable to improve the nutritional well-being of an individual. Furthermore, the other quality attributes of the blends showed that they could be used in the preparation of complementary foods and as substitute raw materials for wheat in the production of pastas, puddings, and biscuits.

Additionally, as cited by Tan (2015), sweet potato has a low Glycemic Index (GI) of 50 whereas white rice has a GI of 70, white bread has a GI of 96 and glucose has a GI of 100. Glycemic Index measures the rate at which an ingested food is converted to glucose in the blood. This makes sweet potato a more food for diabetics. Since sweet potato has a low (GI), it can be an excellent option for individuals looking to manage blood sugar levels, support weight management, improved insulin sensitivity and packed with essential nutrients such as fiber, vitamins (A, C, B6), and minerals (potassium, manganese), contributing to overall health. By choosing the right preparation methods and combining them with other nutrient-dense foods, sweet potatoes can be a valuable component of a healthy eating plan.

Furthermore, in the study of Mohanraj (2014), *Ipomoea batatas (L.) Lam*, also known as sweet potato, is an extremely versatile and delicious vegetable that possesses high nutritional value. It is also a valuable medicinal plant having anti-cancer, anti-diabetic, and anti-inflammatory activities. Sweet potato is now considered a valuable

source of unique natural products, including some that can be used in the development of medicines against various diseases and in making industrial products. The study focused on the nutritional value, health benefits, phytochemical composition, and medicinal properties of sweet potato. Specifically, the biological activities of some of the sweet potato compounds that have been isolated, the pharmacological action of the sweet potato extract, clinical studies, and plausible medicinal applications of sweet potato, and demonstrates the potential of sweet potato as a medicinal food.

Similarly, in the study of Aller et al. (2015), Malunggay-Camote product contains a nutritional value per 100 grams of 320 kilocalories, 12 grams of fats, 50 grams of carbohydrates, 24 grams of sugar, 4 grams of protein, and 100 grams of sodium. Both malunggay and sweet potato leaves are indigenous and inexpensive food ingredients to boost the nutritional quality of various baked products. It was within these contexts that the researchers were challenged to utilize malunggay and sweet potato leaves for dough and sweet potato root for fillings as a main ingredient in formulating pastry and fillings.

In the study of Senthilkumar et al. (2020), sweet potato is not only a source of energy; it also supplies important nutrients mainly, vitamin A, Vitamin B6, Vitamin C, and Vitamin E as well as dietary fiber and they are low fat and cholesterol. It serves as an important protein source for many world populations and is an important source of starch and other carbohydrates. Sweet potato also contains some essential minerals and trace elements such as iron, potassium, calcium, zinc, sodium, magnesium, and manganese.

In addition, Hua et al. (2015), the nutritional values of sweet potatoes have been rediscovered as a functional food, containing high levels of various phytochemicals which have health benefits. Data showed that sweet potato contains rich starch, protein, fat and dietary fiber. Numerous studies suggested that sweet potato is rich in nutrition and nutrient balance. Sweet potato had health care function and medicinal value for different nutrient components such as carotene, vitamin (VB1, VB2, VC, VE), dietary fiber, minerals (K, Ca, Fe, P and Se), dehydroepiandrosterone, slime protein, and anti-cancer activity.

Moreover, Bhuyan et al. (2022), cited sweet potato offers a variety of health benefits such as improving digestion and regularity because of its fiber content. It also protects vision since it has beta-carotene which is essential for eye health. Sweet potato supports vascular health as anthocyanins are present and associated with anti-inflammatory effects that reduce the risk of heart disease. It also reduces oxidative damage and cancer risk, diets rich in antioxidants such as carotenoids are associated with a lower risk of stomach, kidney, and breast cancer.

Moreover, Fider et al. (2016), developed a vegetable-based snack recipe using affordable vegetables such as squash, sweet potato, and some leafy vegetables as its main ingredients that would be affordable and acceptable to school children. Acceptability of the products developed was determined by conducting a consumer survey with

200-grade school children of the Maharlika Village Elementary School in Taguig City. It was expected that the products developed could provide parents and schools with convenient, low-cost, healthy options snack foods that could help address problem in malnutrition, nutrient deficiencies, and school performance of the students.

Moreover, in the study of Kolawole et al. (2018), investigated the suitability of Orange Fleshed Sweet Potato (OFSP) and sclerotium of Pleurotus tubberegium in the production of Cookies. The moisture, protein, fat, ash, crude fiber and carbohydrate content of cookies samples were in the range of 12.04 15.33 percent, 5.66–11.02 percent, 9.72–10.44 percent, 1.27–3.70 percent, 1.01–3.68 percent and 59.84–67.22 percent, respectively. The OFSP based cookies contained appreciably higher amount of minerals and water-soluble vitamins than the control. The 30 percent supplemented OFSP cookies had the highest content of Iron (30.56 milligram/100 gram) and Zinc (5.43 mg/100 gram). According to the study of Olubunmi et al. (2017), orange fleshed sweet potatoes are rich in complex carbohydrates, dietary fiber, β-carotene, vitamin C and vitamin B6. Proximate functional and chemical analysis of the OFSP flour was determined using standard methods. Range of values for moisture, protein, fat, fibre, ash and carbohydrate were 7.76-8.49 percent, 3.14-6.57 percent, 13.94-25.66 percent, 2.83-3.20 percent, 2.70-3.01 percent and 56.31-68.45 percent, respectively. The study showed that Orange Fleashed Sweet Potato could be used for pasta production that is rich in beta carotene.

Similarly, Bonsi et al. (2014), studied the Nutritional Enhancement of Ghanaian Weaning foods using the Orange flesh sweet potato (*Ipomea batatas*) to address the public health problem in Ghana of Vitamin A deficiency (VAD). Research on the orange flesh sweet potato root has been given prominence because of its high β carotene content as a means to enhance the nutritive value and vitamin A content of the traditional diets of Ghanaian children as a long-term intervention towards combating VAD. A higher level of β-carotene was seen in the roasted maize meal weaning foods which makes them a better potential blend for combating Vitamin A difficiency. This will help alleviate vitamin A deficiency of children in Ghana and other countries with similar problems. It is, therefore, recommended that the orange flesh sweet potato flour be used by mothers as an entry point for enhancing the traditional weaning food preparations.

Correspondingly, Haile et al. (2018), assessed the nutritional composition of Orange-Fleshed Sweet Potato and haricot bean formulated mashed food to addressed the Protein-energy malnutrition and vitamin A deficiencies among the public health problems in Ethiopia. Nutrition education using food-based interventions were also recommended in the study area to improve nutritional status of preschool children. By increasing the frequency of consumption (portion size), it is possible to increase the nutrients level in the formulated foods. But, the preschool children are not expected to eat only meal which is prepared from Orange Flesh Sweet Potato and haricot bean in a day. From this study survey, it was observed that they were consuming other foods rich in nutrients, like egg, milk and green vegetables, even though seldom. Therefore, the formulated food can complement the gap of the nutrients to improve the nutritional status of the preschool children. This can be one of the food-based strategies to combat the protein and vitamin A deficiency from locally available crops.

According to Department of Science and Technology (DOST)-Food and Nutrition Research Institute (FNRI), Philippine Food Composition Table Online Database (PhilFCT) reported (2019), a boiled white sweet potato or kamoteng nilaga has 86 percent of edible portion. Based from the report, a 100grams of edible portion has 68.8 g of water, 126 kilocalories of energy, 0.4grams of protein, 0.8gram of fat, 29.3 gram of carbohydrate, 0.7gram of ash, 3.9grams of fiber, 9grams of sugar, 83milligram of calcium, 37 milligram of potassium, 0.7 milligram of iron, 42 milligrams of sodium. The sweet potato has also 5µg beta-Carotene, 0.07 milligram Vitamin B1, 0.02 milligram vitamin B2, 0.2 milligram of niacin and 23 milligrams of Vitamin C.

Similarly, the study of Bach et al. (2021), a 100 grams of raw sweet potato has a nutritive content of water 69.5-81.3 grams, energy 86.0-106.0 kilocalories, protein 1.5 grams, lipids 0.1 grams, carbohydrates 21.3-22.0 grams, dietary fiber 3.0 grams, calcium 39.0-63.0 milligram, iron 0.6-1.3 milligram, magnesium 15.0-37.0 milligram, phosphorous 28.0-51.0 milligram, potassium 191.0-337.0 milligram, zinc 0.3-0.7 milligram, vitamin A 1.0-1371.0 microgram (µg), Vitamin B 82.5 milligram, vitamin B2 47.3 milligram, Vitamin B5 0.55 milligram, Vitamin B6 0.21 milligram, and Vitamin C 3.0 milligram.

In addition, in the study of Dela Cruz (2023), sweet potato and malunggay leaves used in producing a Pandesal as a healthy snack. The finished product composed of 19.09% of Sweet Potato flour, 57.27% of flour, 0.53% of yeast, 0.80% of salt, 12.11% of milk, 9.94% of sugar, and 0.26% of malunggay powder. Eating Pandesal made with sweet potato and malunggay powder offers several health benefits such as calories, carbohydrates, dietary fiber, vitamins and minerals. Incorporating these ingredients into Pandesal significantly enhances its nutritional profile, making it a healthier alternative to traditional Pandesal while providing essential nutrients and health benefits.

Correspondingly, Laelago et al. (2015), used Orange-Fleshed Sweet Potato (OFSP) flour to produce β-carotene Cookies by blending with wheat flour. The proximate composition of Cookies made from composite flours recorded more ash, crude fat, crude fiber, and energy values as the addition of OFSP increased in the blend. The moisture, crude, protein, and carbohydrate contents decreased when more OFSP added to soft wheat flour. Cookies developed up to 40% OFSP supplementation with wheat flour was superior in β-carotene than the wheat flour (control) and it was preferable to vulnerable groups who need pro-vitamin A to combat vitamin A deficiency. The iron and zinc were estimated to be bio available in control /wheat flour, and cookies developed from composite flours namely: BP1, BP2, BP3 and BP4. The physical parameters like width, height and spread factor measurements of Cookies with more OFSP supplementation were shown less bulky, which reduced the packaging, storing, and distribution costs of the product. As a result, the use of OFSP-wheat flour blend in Cookie formulation appeared to be promising from nutritional quality, acceptability, and economical point of view.

Moreover, in the study of de Carvalho (2014), in producing sweet potato flour it weighed, washed in water to remove soil, and then peeled using a knife, washed with tap water, and grated using a motorized grater. After being grated, the material was collected and thoroughly mixed. Part of the sample was stored at 20-degree Celsius for analysis and remainder was used to mix with flour of shredded cassava to make orange fleshed sweet potato.

In addition, Mitiku et al. (2018), stated that to get rid of any extraneous debris that had adhered, sweet potatoes were separated and cleaned. To enable quick drying and simple milling, cleaned sweet potatoes were peeled and cut into slices. The 2-millimeter-thick slices of tubers were blanched in lukewarm water, cooled, drained, and dried in a hot-air oven for six hours at 105-degree Celsius, resulting in a final moisture content of 11.58 percent. Using a laboratory grinder, dry sweet potato slices were grounded into a fine powder and sieved twice through a 0.425 mm mesh sieve. Before being utilized to make bread, the flour samples were kept in airtight polyethylene plastic bags and refrigerated at 4-degree Celsius.

Foods from Malunggay

In the study of Krishnan (2016), stated that moringa has high nutritive values. Every part of the tree is suitable for either nutritional or commercial purposes. The leaves are rich in minerals, vitamins, and other essential phytochemicals. Extracts from the leaves are used to treat malnutrition and augment breast milk in lactating mothers. It is used as a potential antioxidant, anticancer, anti-inflammatory, anti-diabetic, and antimicrobial agent. *M. oleifera* seed, a natural coagulant is extensively used in water treatment. It is claimed that eight ounces of Moringa leaves give 1000 milligrams of calcium and dry Moringa powder can give 4000 milligrams calcium while milk only gives 300-400 milligrams of calcium. Potassium which transmits nerve impulses and its deficiency can cause loss of appetite and sometimes coma. Phosphorus which has role in the formation of bones and teeth, is also needed for the body to make protein for growth, make ATP, maintenance, repair of cells and tissues. Iron can replace iron tablets. Zinc content of Moringa is also in accordance of the dietary requirements, which is important for the Ribonucleic Acid (RNA) and Deoxyribonucleic Acid (DNA) synthesis.

Similarly, the study of Calubaquib et al. (2020), determined the nutritive values of fortified Filipino snacks and calculated the calorie value of the energy-yielding nutrients. It was found that the highest protein was found in Moringa Sweet Potato Tuile, which can replace animal-based street foods. The moisture content of Saba-Potato Halaya was the highest and found lowest in Moringa Polvoron. The dry nature of Moringa Polvoron can prolong its shelf-life. It can substitute candies and gummies. The ash content was found highest in Moringa-Sweet Potato Tuile (MST). This can be associated with the mineral dense Moringa and sweet potato. MST can be a healthier alternative for commercial pastries. The crude fiber content was again observed rich in MST. The Moringa and sweet potato are good fiber sources. MST is a healthier option than any fiber-rich junk food. Crude fat content was

highest in Banana Blossom Bar. This snack can better substitute chocolate-flavored bars. All fortified snack samples are healthy calorie-containing foods suitable for picky-eating children.

Additionally, the study of Abou-Zaid et al. (2014), assessed the nutritional value of moringa leaves of the South African ecotype. The dried leaves had crude protein levels of 20.9%, crude fat 5.22%, ash 10.90%, crude fiber 9.14% and carbohydrates 52.84%. The dried leaves had the following mineral contents percent: calcium (3.65), phosphorus (0.3), magnesium (0.5), potassium (1.5), sodium (0.164), zinc (13.03), copper (8.25), manganese (86.8) and iron (490 mg/100g), plus selenium (36.3 one millionth (µg)/100g). The study was carried out to evaluate the nutritional quality characteristics; with regards the gross chemical composition, essential minerals content, and amino acids composition of moringa leaves, as well as to determine the effect of the incorporation of moringa leaves at different levels, as a new source of protein, on quality characteristics of produced chocolate and sesame sweet.

In the study of Cristuta et al. (2019), cited that "Undernourished and malnutrition are no longer new issues in Filipino learners". It has been reported to have a total of 1,836,793 undernourished pupils from kindergarten to Grade 6 pupils as reported by Department of Education in Fiscal Year 2019. In the latest news, the Programmed for International Student Assessment (PISA) results showed that the Philippines ranked last in reading among 79 participating countries or economies and ranked second to the last in both mathematics and science. The Philippines sees a strong relationship between the socio-economic status of students and their school performance. The study can help the children in performing well in the class by eating nutritious snack to increase the academic engagement.

Furthermore, Sahu et al. (2020), explained that moringa has been used as a traditional medicine around the world for anemia, skin infections back heads, anxiety, bronchitis, chest congestion, asthma, blood impurities, cholera glandular, swelling, headaches, conjunctivitis, cough, diarrhea, eye and ear infections, fever abnormal blood pressure, hysteria, pain in joints, pimples, psoriasis, respiratory disorders, scurvy, semen deficiency, sore throat, sprain, tuberculosis, for intestinal worms, lactation, diabetes, and pregnancy. The leaves possess remarkable nutritional and medicinal qualities. It contains high amount of vitamin C, which fights a host of illnesses including colds and flu; vitamin A, which acts as a shield against eye disease, skin disease, heart ailments, diarrhea, and many other diseases; Calcium, which builds strong bones and teeth and helps prevent osteoporosis; Potassium, which is essential for the functioning of the brain and nerves, and Proteins, the basic building blocks of all our body cells.

Meanwhile, in an article published by Acta Horticulturae (2017), stated that the energy and nutrient content of the five different snack foods utilized in the feeding intervention. The 3 grams of Moringa Leaves Powder (MLP) contains about 11.5 kilocalories, 0.8 g protein, 37.7 milligrams calcium, 0.4 mg iron, 225.9 µg vitamin A, and 2.1

mg vitamin C. Among the snack foods, polvoron gave the highest nutrients per serving. On the other hand, arroz caldo had the least amount of nutrients per serving. Meat was not added to the developed snack foods to avoid confounding with the nutrients from the meat. Flavor enhancers were added instead.

According to the study of Sahay et al. (2017), compared the nutritional content of fresh and dried *Moringa oleifera* leaves per 100 grams revealed that fresh malunggay leaves has 75.5 of moisture, 92kilocalories of energy, 6.7grams of protein, 12.5grams of carbohydrates, 1.7 grams of fat, 0.9 gram of fiber, 220milligrams of Vitamin C, 67800 thousandth of a milligram Beta-carotene, 0.85 milligrams of iron, 440 milligrams of calcium, and 70 phosphorous. On the other hand, oven dried malunggay leaves has 6 of moisture, 271.54 kilocalories of energy, 23.78grams of protein, 28.32grams of carbohydrates, 7.014grams of fat, 11.8 grams of fiber, 56 milligrams of Vitamin C, 37800 micrograms (µg) Beta-carotene, 19 milligrams of iron, 3467 milligrams of calcium, and 215 phosphorous.

According to the study of Ananias (2015), the leaves, pods and seeds of *Moringa oleifera* tree possess enormous nutritional and antioxidant properties. Both fresh and dried moringa leaves can be included in meals and are in use in some African countries. Leaves particularly when dried are easy to handle and store as they have a very good shelf life. Also, after drying, the nutrients are more concentrated, thereby making them even richer and more valuable.

Similarly, Srinivasamurthy et al. (2017) produced a Moringa Muffin. *Moringa oleifera* powder has also been used in the production of muffin, where up to 12 percent concentration (per 55grams of flour used) of dried leaves powder were incorporated. At this concentration, the muffin can be produced successfully with enhanced nutritional qualities and acceptable sensory qualities. The Moringa muffin was found to contain significantly high amount of protein, fat, beta carotene, and vitamin C. The mineral content was also high for Moringa muffin. Calcium, iron, and potassium content of the Moringa muffin was found to increase significantly than the controlled one. Phosphorus content also increased in the Moringa muffin though not significantly.

Additionally, Emilike et al. (2016), studied the effect of different drying techniques (sun dried, oven dried, shadow dried) used to dry Moringa leaves on the Moringa incorporated chin chin. They found that oven dried samples had a reduced fat and moisture content compared to the control. Elemental analysis revealed that oven dried sample had the highest calcium (190.5mg/100g), sun dried highest zinc (7.1milligrams/100grams) and shade dried highest iron content of 51.3 milligrams /100grams.

Stadtlander et al. (2017), studied several species of trees belong to the genus Moringa, but only one, *Moringa Oleifera Lam.*, has been intensively studied. In this study, kernels and leaves of *Moringa Oleifera*, *Moringa stenopetala*, *Moringa drouhardii*, and *Moringa hildebrandtii* have been analyzed for their protein, fat, amino acid,

fatty acid and macro and micro elements and discussed in relation to the known nutritional requirements of a young child. Moringa especially those of *Moringa oleifera* found suitable source of amino acids, vitamins and several elements but not for lipids and fatty acids.

According to Asian Pacific Journal of Cancer Prevention (2014), researchers identified moringa as a plant with numerous health benefits including nutritional and medicinal advantages. *Moringa oleifera* contains essential amino acids, carotenoids in leaves, and components with nutraceutical properties, supporting the idea of using this plant as a nutritional supplement or constituent in food preparation. Some nutritional evaluation has been carried out in leaves and stem. An important factor that accounts for the medicinal uses of Moringa oleifera is its very wide range of vital antioxidants, antibiotics and nutrients including vitamins and minerals. Almost all parts from Moringa can be used as a source for nutrition
with other useful values.

In the study of Babayeju et al. (2014), the organoleptic properties of melon, "egusi" (*Citrullus colocynthis var. Lanatus seed*) and efo riro (Spinach; *Amaranthus spinosus*) soup blends produced with Moringa (*Moringa oleifera*) and spinach leaves were compared. 100 percent moringa had the least acceptability. However, most of the respondents on realizing that moringa leaf was included in the samples indicated their preference and higher rating for the moringa soup blends. The study showed that a 30 percent or lower level of inclusion of moringa leaves in traditional vegetable soup recipes was acceptable to consumers irrespective of whether content of the soup is declared/indicated, and a higher level of inclusion is acceptable when "Moringa" is declared/revealed as a recipe ingredient. Traditional soups used as vehicles or carriers of the nutritional/medicinal qualities of moringa that are preserved during cooking, thereby circumventing negative psychological feeling of using medicines whilst gaining attendant benefits.

According to Croation Journal of Food Science and Technology (2014), moringa a nutrient rich plant that has the potential to combat malnutrition. This study investigated the effect of fortification using *Moringa Oleifera* flower powder on the sensory and proximate attributes of fermented yellow maize and millet blend (Ogi). The proximate composition of fermented yellow maize and millet (Ogi) fortified with *Moringa oleifera* flower powder showed an increase in crude protein, crude fiber, ash and fat with increase in the levels of *Moringa oleifera* flower powder and decrease in carbohydrate and moisture content. Moisture, protein, fibre, fat, ash and carbohydrate contents varied in the range 7.92-9.74percent, 10.46-16.06percent, 2.31-4.13 percent, 2.90-4.07 percent, 1.23-1.93 percent, and 66.45-73.25 percent respectively. Sensory evaluation showed that blend 6 (20 percent *Moringa Oleifera* Flower Powder (MOFP) compared favorably with the control. Also, nutritional analysis showed that blend 6 is favorable as weaning food. Therefore, blend 6 formulation can be used as alternative to the weaning foods to improve the nutritional status of children and help to curb protein malnutrition.

According to the Journal of Food Processing and Preservation (2014), researchers investigated the effect of germinated tigernut and moringa flour addition on the quality characteristics of wheat-based bread. Adding of germinated tigernut and moringa flours to wheat flour increased the protein, crude fiber and ash contents of bread from 13.01 to 19.51percent, 0.77 to 3.71 percent, and 1.21 to 2.63 percent, carbohydrate content decreased from 59.06 to 41.98 kilocalories. Iron, calcium, and magnesium contents of bread increased from 2.03 to 3.68 milligrams/100 grams, 46.37 to 57.12 milligrams /100 grams, and 68.47 to 108.44 milligrams /100 grams, respectively, whereas sodium decreased from 189.20 to 136.69 milligrams /100 grams.

Additionally, The Pharma Innovation Journal (2019), stated that there were chemical and phytochemical properties of dried *M. oleifera* leaf powder. Dried moringa leaf powder exhibited moisture levels 72.83percent, ether extract 9.53percent, crude fibre 22.03percent, total minerals 9.53percent, crude protein 20.42percent, and carbohydrates 50.16percent. The predominant mineral elements in the dried moringa leaf powder were Calcium, Magnesium, Potassium, Iron, Copper, 2032.83, 387.83, 1545.33, 26.69, 0.83 milligramsg/100grams respectably. The phytochemical properties revealed that the ascorbic acid and total phenols and Antioxidant activities of dried moringa leaves 106.28, 253.00 mg/100g
activity respectively.

According to Echo Community (2020), dried and fresh leaves appear to contain a substantial amount of the magnesium, iron, folate, and vitamins B-6, A, C, and E that young children need. They are also a moderately good source of calcium, niacin, protein and dietary fiber. A one cup serving of fresh, raw leaves appears to be a better source of a number of vitamins, especially vitamin C. However, vitamin levels will likely drop if the leaves are cooked. It is important to note that for many of these nutrients the data is limited or highly variable.

According to National Nutrition Council (2021), malunggay leaves are a natural galactagogue, a substance that promotes or increases the flow of a mother's milk. Malunggay is widely acknowledged to be the most nutrient-dense food in the world, moringa leaves are rich in five essential vitamins and minerals including iron, calcium, vitamins A, E and K. It is also a complete source of plant protein with all nine essential amino acids, high in fiber and contains exceptionally high levels of antioxidants.

In the study of Toshi (2023), medically reviewed that Moringa has an amazing health benefit. Moringa leaves are rich in vitamins A, C, B1 (thiamin), B2 (riboflavin), B3 (niacin), B6 and Folate. They are also rich in magnesium, iron, calcium, phosphorus, and zinc. One cup of moringa leaves will contain two grams of protein, magnesium (eight percent of the RDA), Vitamin B6 (nineteen percent of the RDA), Iron (eleven percent of the RDA), Riboflavin (eleven percent of the RDA) and Vitamin A (nine percent of the RDA). Moringa leaves are rich in vitamin C and beta-carotene that act against free radicals. They also have Quercetin which is an antioxidant that helps to lower blood pressure. Another antioxidant that is present in moringa leaves is Chlorogenic acid which

helps to stabilize blood sugar levels post meals. A study in women showed that taking one- and one-half teaspoons of moringa leaf powder regularly for three months had shown a significant increase in blood antioxidant levels.

According to European Journal of Pharmaceutical and Medical Research (2016), moringa is a miracle tree with a great indigenous source of highly digestible proteins, Ca, Fe and Vitamin C. It contains all the essential nutritional elements that are vital for livestock and human beings. It has been demonstrated that the dry leaves of *M. oleifera* contain seven times more vitamin C than orange, ten times vitamin A than carrot, seventeen times calcium than milk, fifteen times potassium than bananas, twenty-five times iron than spinach and nine times proteins than yogurt. In addition, it contains vitamin B, chromium, copper, magnesium, manganese, phosphorus and zinc.

However, Abioye et al. (2015), used the moringa powder in their study where (*Moringa oleifera)* leaf powder was produced as follows, freshly plucked moringa leaves were weighed, cleaned (rinsed), and dried at 45°C in the cabinet dryer. It was then blended, allowed to cool, and packaged in cellophane bags until it was needed for further use. Ogi powder was supplemented with dried moringa leaves at substitution levels of 0, 10, and 15, and then mixed thoroughly to obtain homogenous moringa-ogi powder.

As explained by Akajiaku et al. (2018), stated that fresh leaves of *Moringa oleifera* were manually sorted after harvesting; the diseased and damaged leaves were removed. Selected leaves were washed in running tap water to remove dirt. Water was removed from the surface of the leaves and then allowed to dry in the oven for 30 min at 50-degree Celcius. The dried leaves were ground and a screen of 0.5mm-10mm pore size was used for the separation of the fine powder. *Moringa oleifera* leaves powder was dried at a temperature of 40-degree Celcius for 30 minutes.

Acceptability of Innovative Products

According to Castro (2019), the level of acceptability of innovative recipes from squash (Squash candy, Puto de Kalabasa, Nutri-Nuggets Squash, Dynamite Squash Blast, and Pasta de Kalabasa) was determined by sensory evaluation. Overall, the level of acceptability of innovative recipes from squash ranged from “acceptable to highly acceptable” in terms of color, taste, aroma, texture, and appearance. On the other hand, shelf-life varies between recipes when at room temperature and refrigerated.

Similarly, in the study of Beatriz (2019), the sensory attributes were employed in evaluating the product in terms of color, taste, aroma, texture, appearance, and shelf-life. The results of the sensory evaluation showed the first trial was the most acceptable proportion and interpreted as highly acceptable using 1 and ¼ cup of all-purpose flour and ¾ cup of coconut meal. The bigger amount of coconut meal added to the cupcake the softer the texture of the *Cocus Nocifera* Cupcake and sweet smelling of “Sapal” was pronounced. Based on the ocular observation

conducted on the shelf-life of the *Cocus Nucifera* Cupcake, it was found that the Cupcake lasts for six (6 days and is fit for human consumption at room temperature.

Additionally, Tamayo et al. (2020), processed bamboo shoot into a Cupcake and assessed the sensory quality, consumer acceptability, and proximate analysis. For the four treatments used, the researchers' experimental design was used. Purposefully chosen respondents were used to assess the color, texture, and taste using sensory scales, and their acceptability on a 9-point hedonic scale. The results have shown that treatment two was the most acceptable among all other treatments with a mean value of 7.95, interpreted as very much. Thus, the incorporation of shredded bamboo shoots into Cupcakes is widely acceptable among its consumers and can be a good source of healthy alternative snacks for children.

Also, in the study by Ramirez (2021), it was determined its effects on Camote Pie. Crust and filling preparations were subjected to organoleptic tests using the 9-point hedonic scale in terms of food attributes by the different panelists including food experts, students, and professors. There were four treatments for crust and filling. Results showed that in terms of odor, texture, flavor, and general acceptability all the treatments for fillings were rated as very much while for the crust, the texture and flavor were rated as moderately. It was then showed that there is a highly significant mean difference in the respondents' group/panelists' perception of crust and filling texture, odor, and flavor but no significant difference in Camote Pie general acceptability. Nutrition facts of Camote Pie for 900 grams content based on 2015 Recommended Energy Nutrient Intake (RENI) Philippine Dietary Reference Intake (PDRI) adult requirements of nineteen to twenty-nine years old males showed that calories (kilocalories) are 13 percent, cholesterol (milligrams) is 30 percent, total carbohydrate is 15 percent and protein is 8 percent.

Moreover, Butke et al. (2018), evaluated the sensory acceptability among children and physicochemical composition of Pizza that have developed with the addition of different pumpkin skin flour. Five pizza formulations were developed with the addition of different levels of Pumpkin Skin Flour: F1 (0%), F2 (12%), F3 (18%), F4 (24%), and F5 30%). The results concluded that an added level of up to 18% Skin Pumpkin Flour in pizza improves the product's nutritional profile and is well-accepted by the children.

Siling Labuyo (*Capsicum frutescene*) Flavored Cakes and Cookies, studied by Angeles (2018), pulverized siling labuyo was used to flavour cakes and cookies. Descriptive and sensory evaluation in terms of taste, color, aroma, texture, and appearance was used in the study to determine the acceptability level of spices of the baked products.

Then, Biao et al. (2019), studied creating a healthier version of Cookies by replacing some of the wheat flour with 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 cookie sensory evaluation. Then, they were asked to evaluate the color of the Cookies first

and then to evaluate their mouthfeel, 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 the above sensory parameters. Panelists rinsed their mouths with water between sample evaluations. A nine-point hedonic scale was used for sensory evaluation. In conclusion, results showed that cookies with acceptable textures and appearances
could be produced by replacing up to 15 percent of wheat flour with mushroom flour.

In addition, Bantog (2015), studied an ice cream utilizing ripe tiessa and pili pulp. Researcher applied developmental, descriptive, and evaluative methods to determine the acceptability of the finished product. Also, the study of Lalugan (2015), focused on the utilization of Indian Mango fruit as the main ingredient for wine. Sensory evaluation was used to determine the degree of acceptability of the product in terms of appearance, color, clarity, aroma, and taste. The physicochemical composition of the different samples of Indian mango wine was evaluated in terms of alcohol content.

The study of Sarte (2016), focused on utilizing banana pith as the main ingredient in different recipes such as banana pith pickles, banana pith chutneys, banana pith fritters “Okoy”, banana pith patties, and banana pith balls. The study was significant because the sensory evaluation was used to determine the degree of acceptability of the different food products for banana pith. In addition, Aliteg (2015), determined the acceptability Chiffon cake using sweet potato, saluyot, malunggay, and cacao. Based on the findings of the study prepared Chiffon cake with three different proportions was accepted to the teenagers, young adults, and adults in terms of appearance, aroma, taste, texture, and color.

Another study by Refardo et al. (2023), used sweet potato flour and toasted rice to produce a Polvoron. The product was described to be highly acceptable in terms of palatability, texture, aroma, color, and appearance. The data revealed that sweet potato flour and rice coffee can be the base ingredients in making Polvoron. Thus, it is recommended that the texture shall be more refined. The product can be a good input to start up.

Similarly, in the study of de Brito et al. (2019), the Muffin used formulations from different alternative flours. Products were evaluated using color, taste, odor, texture, and overall impression. Also, Zaldariaga (2022), study was formulated to determine the level of acceptability of Chili Sweet Potato Pie. The sweet potato pies were subjected to organoleptic evaluation. The three categories are taste, general acceptability, and texture. Descriptive analyses were utilized, and the results showed very satisfactory descriptions were verbally interpreted as “Highly acceptable”. Sweet potato enhanced with “Siling labuyo” has great dessert potential.

The study of Burce (2016), focused on the acceptability of black plum seed as the main ingredient for coffee. Black plum seeds are typical fruits usually eaten while the seed is thrown away unaware of the other use for it and

its nutritional content. Same with Soverano's study (2016), about processed wine from lubas fruit, found that all treatments were significantly varied in terms of aroma, taste, and appearance.

Furthermore, the study by Alano (2023), focused on using the dragon fruit peel to make a candy that can be a source of income. The study determined the acceptability of innovative products from dragon fruit peel in terms of organoleptic attributes. The study of Imperial (2014), about the tapol variety of adlay which was formulated into an instant nutri-meal. Product was evaluated as to its sensory characteristics, physicochemical properties, microbial load, and proximate analysis for the acceptable formulation. The result was high in terms of the data gathered from the respondents.

According to the study of Mercadal et al. (2022), Squash Cupcake was acceptable in terms of their appearance, texture, color, taste, aroma, fluffiness, and including its general acceptability. Furthermore, Wilton et al. (2022), focused on the utilization of jackfruit seed flour in Pandesal. To determine if there is significance in the level of acceptability of jackfruit seed flour as a substitute in making Pandesal in three formulations as to its appearance, aroma, taste, texture, and general acceptability. Results revealed that there was a significant difference in the level of the acceptability of jackfruit seed flour as a substitute in making Pandesal to three formulations A, B, and C in terms of appearance, aroma, taste, and texture. However, in terms of general acceptability, the result revealed that there was no significant difference in three formulations.

The cupcakes must have a smooth and firm texture according to the study of (James, 2018) sensory evaluation on flavor, volume and texture of substituting amaranth flour for wheat flour in Red Velvet Cupcakes. According to Grove (2022), Cupcake can last between two to five days, but by using suitable cupcake boxes they should keep their freshness for up to a week. Plain cupcakes without any icing or frosting can keep for up to a week on your kitchen counter, but iced cupcakes, or those with a sweet filling, will only last two to four days. Cupcakes topped with buttercream or other dairy ingredients need to be stored in the fridge and can last for three to five days refrigerated. Homemade cupcakes can last between two to three days in a closed container. After removing the cupcakes from the oven, make sure that you cool them on a wire rack before putting them into a box, otherwise the trapped steam in the container will cause condensation which will make them soggy.

Methodology

This study used both descriptive experimental and research and development methods. The Descriptive method used to describe the level of acceptability of the Cupcake made from sweet potato and malunggay as the main ingredient through sensory evaluation. The Experimental method was also used in the formulation of the different formulations and measurements of ingredients. The research and development method used in gathering data and during the production of sweet potato and malunggay Cupcake. The respondents of this study were purposively chosen. These included stakeholders across age groups from Ponong, Magarao, Camarines Sur. Respondents were

identified according to the set of criteria. Age groups include children who were 6 to 12 years old; senior high school students or young adults who were 18 to 24 years old; teachers or middle-aged adults who were 35 to 45 years old and, parents or older adults who were 46 - 60 years old. Respondents were ten (10) children and ten (10) parents from Ponong, Magarao, Camarines Sur, ten (10) Senior High School Technical Vocational Livelihood students and ten (10) teachers teaching in Ponong Integrated School. Ten (10) were taken from each group. Hence, there were forty (40) respondents in all. This study used questionnaire primarily to determine the level of the acceptability of the finished product in terms of color, taste, aroma, texture, and appearance and were statistically treated using weighted mean.

Results and Discussion

Nutritive Value of Sweet Potato

Sweet potatoes *Ipomoea batatas* was adaptable root vegetables valued for their substantial health advantages and rich nutritional composition. A staple food in many regions of the world, it provides a nutrient-dense, high-energy choice that can meet dietary needs for a wide range of people. There were several nutritive content and health benefits of sweet potato. According to United States Department of Agriculture National Agricultural Library 2015 and DOST-Food and Nutrition Research Institute (2019) as shown in Table 3, for every 100 grams of raw sweet potato, it contains 86.0 kilocalories energy, 1.6 grams protein, 0.1 grams total lipid fat, 20.1 grams carbohydrates, 3.0 g fiber, 4.2 grams of sugar, 30 milligrams calcium, 25 milligrams magnesium, 55 milligrams Sodium, 2.40 milligrams total ascorbic acid, 0.08 milligrams thiamin, 0.06 milligrams Riboflavin, 0.56 milligrams Niacin, 0.209 milligrams Vitamin B-6, 11 micrograms Dietary Equivalent Folate (µg-DEF) folate, 0.26 milligrams Vitamin E, 1.8 micrograms (µg) Vitamin K, and 14187 International Unit (IU) of Vitamin A.

Table 3

Nutritive Value of Raw Sweet Potato and Cooked Sweet Potato

Nutrients	USDA National Agricultural Library 2015	DOST-FNRI (PhilFCT) 2019
	Raw Sweet Potato	**Cooked Sweet Potato**
Energy	86.0 (kcal)	126 g
Protein	1.6 g	0.4 g
Lipid fat	0.1 g	0.8 g
Carbohydrates	20.1 g	29.3 g
Fiber	3.0 g	3.9g
Sugar	4.2 g	9 g
Calcium	30 mg	83 mg
Magnesium	25 mg	-
Sodium	55 mg	42 mg

Vitamin C	2.40 mg	23 mg
Vitamin B1	0.08 mg	0.07 mg
Vitamin B2	0.06 mg	0.2 mg
Niacin	0.56 mg	0.2 mg
Vitamin B-6	0.209 mg	-
Folate	11 µg DFE	-
Vitamin E	0.26 mg	-
Vitamin K	1.8 µg	-
Vitamin A	14187 IU	-
Ash	-	0.7 g
Potassium	-	37 mg

Additionally, DOST-Food and Nutrition Research Institute, Philippine Food Composition Table Online Database (PhilFCT), a boiled white sweet potato or kamoteng nilaga has 86% of edible portion and a 100grams of edible portion has 126 kilocalories of energy, 0.4grams of protein, 0.8grams of fat, 29.3 grams of carbohydrate, 0.7gram of ash, 3.9grams of fiber, 9grams of sugars, 83milligrams of calcium, 37milligrams of potassium, 0.7milligrams of iron, 42milligrams of sodium. The sweet potato has also 5 microgram (µg) beta-Carotene, 0.07milligrams Vitamin B1, 0.02milligrams vitamin B2, 0.2milligrams of niacin and 23milligrams of Vitamin C. It was evident that consumption of a high amount of sweet potato helps maintain a healthy body.

According to the Table 3 presented, both raw and cooked sweet potato contained different vitamins and minerals. The energy; lipid fat; carbohydrates; fiber; sugar; calcium; Vitamin C; and Potassium are higher in cooked sweet potato compared to raw sweet potato. On the other hand, the protein, magnesium, sodium, Vitamin B1, Vitamin B2, niacin, and Potassium are higher in raw sweet potato compared to cooked sweet potato. Additionally, Vitamins B6, Vitamin E, Vitamin K, Vitamin A, and folate are not found to cooked sweet potato. Although there are vitamins and minerals found and high in raw sweet potato, people preferred to cooked sweet potato in different cooking method like boiling, baking, steaming, roasting and many other ways of cooking. There are also reasons why people prefer to cooked or processed the sweet potato for safe consumption. These are digestibility, nutrient absorption, natural toxins, taste, and texture. The present study dried the sweet potato to make it as one of the main ingredients in making a Cupcake as an alternative healthy snack. Aside from that, the dried sweet potato can last for a year if properly dried and stored for future consumption and make it a Cupcake or any other products that can be used as a healthy snack or food.

Similarly, since sweet potato has fiber content El-Tayeb et al. (2015), stated that sweet potato plays a favorable role in reducing the blood cholesterol level. It also helps to regulate bowel movements by adding bulk to the stool, which can prevent constipation and promote overall digestive health. Fiber-rich foods like sweet potatoes make

you feel fuller for longer, reducing the likelihood of overeating. This can be beneficial for weight management or weight loss.

Additionally, Bhuyan et al. (2022), stated that sweet potato offers variety of health benefits such as improving digestion and regularity because of its fiber content. Beta-carotene is a precursor to vitamin A, meaning the body can convert it into this essential nutrient. It also protects vision since it has beta-carotene which is essential for eye health. It helps prevent night blindness and can reduce the risk of age-related macular degeneration, a leading cause of blindness.

Nutritive Value of Malunggay Leaves

Malunggay *Moringa oleifera*, sometimes called the "miracle tree," are highly valued for their exceptional nutritional value and health advantages in traditional medicine and cuisine. It provides a powerful combination of nutrients that are vital for sustaining general health. These nutrients include calcium, potassium, iron, and several other minerals. In addition, these are a great great source of antioxidants, anti-inflammatory substances, and plant-based protein, which makes them an important dietary element in the fight against malnutrition and in favor of immune system health. With an emphasis on their potential to improve dietary quality and promote health in a variety of populations, especially in areas where there were nutritional shortages, this research study intends to explore the broad nutritional value of malunggay.

Table 4

Nutritive Value of Fresh Malunggay and Dried Malunggay

Nutrients	FRESH	DRIED
Moisture	75.5	6
Energy	93 Kcal	271.54Kcal
Protein	6.7g	23.78g
Carbohydrates	12.5g	28.32g
Fat	1.7g	7.014g
Fiber	0.9g	11.8g
Vitamin C	220mg	56mg
Beta-carotene	67800(µg)	37800(µg)
Iron	0.85mg	19mg
Calcium	440mg	3467mg
Phosphorous	70mg	215mg

There were abundant health benefits and nutrients from malunggay. In the study of Sahay et al. (2017), as shown in Table 4 compared the nutritional content of fresh and dried *Moringa oleifera* leaves per 100 grams revealed that fresh malunggay has 75.5 of moisture, 92kilocalories of energy, 6.7grams of protein, 12.5grams of carbohydrates, 1.7grams of fat, 0.9grams of fiber, 220milligrams of Vitamin C, 67800micrograms (µg) Beta-carotene, 0.85mg of iron, 440 milligrams of calcium, and 70 milligrams phosphorous. On the other hand, oven dried Malunggay has 6 of moisture, 271.54kilocalories of energy, 23.78grams of protein, 28.32grams of carbohydrates, 7.014grams of fat, 11.8g of fiber, 56 milligrams of Vitamin C, 37800micrograms (µg) Beta-carotene, 19 milligrams of iron, 3467 milligrams of calcium, and 215 milligrams phosphorous.

Additionally, dried malunggay contained 3467 milligrams of Calcium and fresh malunggay contains 440 milligrams. In the study of Krishnan (2016), it was claimed that an ounce of moringa give higher amount of calcium from dried moringa powder compared to fresh malunggay. Extracts from the leaves were used to treat malnutrition and augment breast milk in lactating mothers. It was also used as a potential antioxidant, anticancer, anti-inflammatory, anti-diabetic, and antimicrobial agent. Besides, dried malunggay contains 215 milligrams of Phosphorus and 70 milligrams from fresh malunggay leaves which has role in the formation of bones and teeth. Additionally, dried malunggay leaves contains 11.8grams of fiber and 0.9grams from fresh malunggay.

Based from the Table 4 presented, both fresh and dried malunggay contained different vitamins and minerals that people need to become healthy and away from different diseases. On the other hand, the energy, protein, carbohydrates, fat, fiber, iron, calcium and phosphorous are higher in dried malunggay compared to raw malunggay leaves. Moisture, Vitamin C, and Beta-Carotene are higher on fresh malunggay compared to dried malunggay. The researcher decided to dried the malunggay and make it as one of the main ingredients in making Cupcake because of the nutritive value of dried malunggay, it improved and enhanced the flavor of a malunggay when it mixed to other ingredients to make a Cupcake, and to prolong the shelf-life of malunggay that last for a month if properly dried and stored that will use for future consumption.

Process in Producing Sweet Potato Flour and Malunggay Powder

Figure 4 shown the process in producing sweet potato flour. It was illustrated the flow of the procedure in producing sweet potato flour. In the preparation, the first step was the collection of the fresh and good-quality sweet potato, then it was washed and cleaned in clean water to remove dirt and harmful bacteria that may cause contamination then peeled off the skin. Next, it was grated or shredded for fast drying. Then it was arranged on a tray and dried for 3 to 5 hours under high heat of the sun. After drying, it was pulverized using blender and then sieved to achieved the finest texture. Lastly it was stored in a sterilized jar or a plastic then it was sealed. plastic to prolong the shelf-life and for the preparation of the Cupcake.

1. Collecting washing, and peeling of sweet potato of the good quality sweet potatoes.

2.Grating or shredding of sweet potato for fast drying.

3.Arranging the grated or shredded sweet potato on a tray and sun drying for four to seven hours under the sun

4.Pulverizing and sieving of dried sweet potato to produce a fine texture of powder.

5.Storing of sweet potato flour in a sterilized jar or

Figure 4

Producing Sweet Potato (*Ipomoea batatas*) Flour

Additionally, in Figure 5 it was illustrated the flow of the procedure in preparing the malunggay powder. In the preparation of malunggay *(Moringa Oleifera*) powder, after collecting the malunggay it was removed from the stalks and arranged on a tray. Then it was dried in an oven dehydrator for 15 to 30 minutes in a 100-degrees Celsius temperature. After drying, it was pulverized using blender and sieved to achieve the finest texture of malunggay powder. Lastly it was stored in a sterilized jar or a plastic.

On the other hand, in the preparation of Malunggay (*Moringa oleifera)* powder according to Abioye et al. (2015), freshly plucked Moringa leaves were weighed, cleaned, and dried at 45 degrees Celsius in the cabinet dryer. Previous study and the present study used an oven dryer, but present study followed the 100 °C of oven temperature for 30 to 45 minutes.

1. Collecting of good quality malunggay leaves.
2. Removing the leaves from the stalk and arranging on a tray.
3. Oven drying malunggay leaves for 30 to 45 minutes in 100 degrees Celsius.
4. Pulverizing and sieving the dried malunggay leaves to become fine texture powder.
5. Storing of malunggay leaves powder in a sterilized jar or plastic to prolong the shelf life and for the preparation of the Cupcake.

Figure 5

Producing Malunggay (*Moringa Oleifera*) Powder

Best Formulation in Making Sweet Potato and Malunggay Cupcake

To determine the best formulation of Cupcake, there were three trials conducted by the researcher in the formulations of ingredients specifically the sweet potato flour, malunggay powder, and all-purpose flour because the other ingredients used in the Cupcake remained the same. Each formulation has different results in terms of color, aroma, taste, texture and appearance. The illustrations of the different formulations of sweet potato and malunggay batter mixture consistency was presented in (Appendix G). After combining all the different ingredients with different formulations, the color, aroma, texture, and appearance of the formulations were differed. Formulation 1 has a caramel brown color; Formulation 2 has a peanut brown color, and Formulation 3 has mustard yellow color of batter because the different measurements of ingredients used. Consistency of the batter mixture in F1 was thick and slightly pourable, F2 was slightly thick and slightly pourable, and F3 was slightly thick and pourable when it poured on the Cupcake liner. Aroma and appearance of the batter mixture in three formulations were differed as well because of the different amount of the ingredients used.

Disclosed in Figure 6, is the flowchart of experimentation in making Cupcake with the different measurements of sweet potato flour, malunggay powder, and all-purpose flour. Other ingredients have the same measurement like one tablespoon of baking powder, one-half teaspoon baking soda, one-half teaspoon iodized salt, one-half bar butter, one cup muscovado sugar, two large whole eggs, one teaspoon vanilla, one cup evaporated milk, and one-half bar of grated cheese. Formulation 1 contained 2 cups of sweet potato flour; Formulation 2 contained

Sweet Potato and Malunggay Cupcake

Proportion 1	Proportion 2	Proportion 3
2 Cup Sweet Potato Flour	1½ Cup Sweet Potato Flour	1 Cup Sweet Potato Flour
	½ Cup All Purpose Flour	1 Cup All Purpose Flour
2 Teapoon Malunggay Powedr		
1 Tablespoon Baking Powder		
½ Teaspoon Baking soda		
½ Teaspoon iodized salt		
½ bar Butter		
1 Cup Muscovado sugar		
2 large whole eggs		
1 Teaspoon Vanilla extract		
1 Cup Evaporated milk		
½ Cup grated cheese		

Mis in place, prepare the tools, utensils, and equipment. Preheat your oven to 150°C. Line a cupcake tin with paper liners. Sift the SPF and APF, then measure all the dry ingredients. In a bowl, combine together the SPF, APF, malunggay powder, baking powder, baking soda, and salt then set aside. In a large mixing bowl, cream together the softened butter and sugar until light and fluffy. Add the eggs one at a time, beating well after each addition. Stir in the vanilla extract. Gradually add the dry ingredients to the creamed butter, alternating with evaporated milk. Begin and end with the dry ingredients, mixing until just combined. Then add the grated cheese. Be careful not to overmix, as it can lead to dense cupcakes. Spoon the batter into the prepared cupcake liners. Bake in the preheated oven with 150 °C for approximately 20 to 30 minutes or until a toothpick inserted into the center comes out clean. The baking time may vary, so start checking around 15 minutes. Allow the cupcakes to cool in the tin for a few minutes before transferring them to a wire rack to cool completely.

PACKAGING

PROCEDURE

Figure 6

Flow Chart of Experimentation in making Cupcake with the Different Formulations of Ingredients

one and one-half cup sweet potato flour and one-half cup all-purpose flour; and Formulation 3 contained one cup sweet potato flour and 1 cup all-purpose flour.

All tools, utensils and equipment must be ready and prepared. Then, measure all the ingredients accurately and line the cupcake tin with paper liners. In a bowl, dry ingredients were combined, sift and then set aside. In another large mixing bowl, cream together the softened butter and sugar until light and fluffy. Add the eggs one at a time, beating well after each addition and stir in the vanilla extract. Gradually add the dry ingredients to the creamed butter, alternating with evaporated milk. Begin and end with the dry ingredients, mixing until just combined. Then, add the grated cheese. Be careful not to overmix, as it can lead to dense cupcakes. Spoon the batter into the prepared cupcake liners. Bake in a preheated oven with a 150-degrees Celsius temperature for approximately 20 to 30 minutes or until a toothpick inserted into the center comes out clean. The baking time may vary, so start checking around 15 minutes. Allow the cupcakes to cool in the tin for a few minutes before transferring them to a wire rack to cool completely.

On Table 5, through the respondents and evaluators observation, Formulation 3 got the highest score of 3.29 average weighted mean with "highly acceptable" interpretation among the three formulations. Formulation 2 got 3.23 and Formulation 1 got 2.69 average weighted mean. Both F2 and F1 corresponds with "moderately acceptable" interpretation.

Table 5

Formulations in Making Cupcake Using Sweet Potato Flour and Malunggay Powder

Formulations	Quality Attributes	Weighted Mean				Average Weighted Mean	Int.	Rk.
		(A) Children	(B) Students	(C) Parents	(D) Teachers			
F1	Color	2.00	2.10	2.10	3.30	2.38	LA	3
	Taste	3.20	2.30	2.50	3.30	2.83	MA	
	Aroma	3.10	2.60	3.00	3.10	2.95	MA	
	Texture	3.40	2.70	1.90	3.00	2.75	MA	
	Appearance	2.40	2.20	2.20	3.40	2.55	MA	
	Overall	2.82	2.38	2.34	3.22	2.69	MA	
F2	Color	3.80	3.20	3.00	3.30	3.33	HA	2
	Taste	2.70	3.10	3.30	3.40	3.13	MA	
	Aroma	3.20	3.60	3.40	3.30	3.38	HA	
	Texture	2.90	3.30	3.30	3.20	3.18	MA	
	Appearance	3.30	3.00	2.80	3.50	3.15	MA	
	Overall	3.18	3.24	3.16	3.34	3.23	MA	
F3	Color	3.20	3.30	3.80	3.10	3.35	HA	1
	Taste	3.00	3.20	3.30	3.10	3.15	MA	
	Aroma	2.70	3.10	2.70	3.10	2.90	MA	
	Texture	2.90	3.10	3.40	3.30	3.18	MA	
	Appearance	3.60	3.90	4.00	4.00	3.88	HA	
	Overall	3.08	3.32	3.44	3.32	3.29	HA	

Legend:

AVM:	Average Weighted Mean	F1 – Formulation 1
Rk.:	Rank	F2 – Formulation 2
Int.:	Interpretation	F3 – Formulation 3

Weight	Range	Sensory Characteristics
1	1.00 to 1.75	Least Acceptable (LsA)
2	1.76 to 2.50	Less Acceptable (LA)
3	2.51 to 3.25	Moderately Acceptable (MA)
4	3.26 to 4.00	Highly Acceptable (HA)

Level of Acceptability of Sweet Potato (*Ipomoea batatas)* and Malunggay (*Moringa Oleifera*) Cupcake

The acceptability of the Sweet Potato and Malunggay Cupcake and the summary of results from the sensory evaluation of the respondents in terms of color, taste, aroma, texture, and appearance from barangay Ponong, Magarao, Camarines Sur, was shown in Table 6. The acceptability level was rated and evaluated by the four groups of respondents. Respondents were composed of ten

Table 6

Acceptability Level of a Cupcake using Sweet Potato and Malunggay

Quality	Types of Formulation					
	F1		F2		F3	
	WM	Int.	WM	Int.	WM	Int.
Color	2.38	LA	3.33	HA	3.35	HA
Taste	2.83	MA	3.13	MA	3.15	MA
Aroma	2.95	MA	3.38	HA	2.90	MA
Texture	2.75	MA	3.18	MA	3.18	MA
Appearance	2.55	MA	3.15	MA	3.88	HA
Overall	2.69	MA	3.23	MA	3.29	HA
Rank	**3**		**2**		**1**	

Legend:	Rating scale:	Interpretation
F1 – Formulation 1	1.00 to 1.75	Least Acceptable
F2 – Formulation 2	1.76 to 2.50	Less Acceptable
F3 – Formulation 3	2.51 to 3.25	Moderately Acceptable
WM – Weighted Mean	3.26 to 4.00	Highly Acceptable
Int. – Interpretation		

(10) children, ten (10) parents, ten (10) students, and ten (10) teachers from Ponong, Magarao, Camarines Sur.

Color. In terms of color, based on the evaluation and observations of all the respondents, F3 got the highest score of (3.35) followed by F2 that obtained (3.33) average weighted mean. Both F3 and F2 corresponds with "highly acceptable" interpretation, while F1 obtained 2.38 with a "less acceptable" interpretation.

Taste. The rating of Sweet Potato and Malunggay Cupcake based from the respondents in terms of taste F3 got the highest score of (3.15), followed by F2 yielded (3.13), and F1 yielded (2.83). All formulations in terms of taste corresponds with "moderately acceptable" interpretation to all the respondents

Aroma. The Aroma of F2 got the highest score of (3.38), followed by F1 got 2.95, and lastly F3 got the score of (2.90) average weighted mean. The aroma of F1 and F3 corresponds with "moderately acceptable" interpretation while F2 got the highest score and corresponds the "highly acceptable" interpretation. The Cupcake produced a natural aromatic smell because of the natural ingredients used like the sweet potato, malunggay, muscovado sugar and other ingredients that makes the Cupcake produced an aromatic smell.

Texture. Based on the Table 2, the rubrics and rating scale in evaluating the finished product Formulation 3 and Formulation 2 got the highest and the same score of (3.18). On the other hand, Formulation 1 got the lowest score of (2.75) and all the formulations corresponds to "moderately acceptable" interpretation to the respondents.

Appearance. Appearance of the product was important characteristics of a Cupcake because it sets its value. Respondents favored to F3 with the score of (3.88) that corresponds with "highly acceptable" interpretation. F3 produced an appealing, smooth tops, uniform size and shape. F2 has a rating of (3.15) and F1 has a rating of (2.55). As presented and interpreted in Table 6, it showed that both F2 and F1 were "moderately acceptable".

In general, the results of the evaluation gathered from the evaluators was evidenced-based on the weighted mean of each formulations. General acceptability of Sweet potato and Malunggay Cupcake were corresponded from "moderately acceptable" to "highly acceptable" to the evaluators and respondents of this study. Among the different Cupcake evaluated by the respondents, Formulation 3 got the highest average weighted mean of 3.29 and was "highly acceptable" to the liking of the respondents. Formulation 2 got the average weighted mean of 3.23 and Formulation 1 got 2.69. Both proportions of F2 and F1 were "moderately acceptable" based on the sensory evaluation in terms of color, taste, aroma, texture, and appearance. The results of evaluations showed that there were differences in the level of acceptability of the different formulations used by the researcher in producing

Sweet Potato *(Ipomoea batatas*) and Malunggay (*Moringa oleifera)* Cupcake was effective and can be an alternative main ingredient in making Cupcake and make it as an alternative healthy snack.

Shelf-Life of Sweet Potato (*Ipomoea batatas*) and Malunggay (*Moringa oleifera*) Cupcake

	F1	F2	F3
Day 1 -4			
Remarks	Constant shelf–life. Fit and safe for human consumption with quality in terms of sensory attributes.		
Day 5			
Remarks	F1 and F3 already had few spots of molds. F2 were slightly moist.		
Day 6			
Remarks	Increased molds in all three formulations on the 6th day and on the next succeeding days. F1 contained many molds due to 100% of sweet potato and F2 contains contained of 75% of sweet potato. Sweet potato flour helps in preserving the shelf life of the finished product because the moisture content of it was removed. Adding 50% of APF and 50% SPF in F3 helped to achieve the good appearance and makes the cupcake firm. The molds in F3 were also less compared to F1 and F2.		

Observation on Different Formulations of Sweet Potato (*Ipomoea batatas*) and Malunggay (*Moringa Oleifera*) Cupcake

Figure 7

Shelf – Life of Cupcake at Room Temperature

Shelf-life of innovative food products plays a crucial role in determining the overall success and acceptance in the market. By ensuring product quality and safety, enhancing economic viability, complying with regulations, and

reducing environmental impact, shelf-life is a critical factor that researchers must carefully consider. Understanding and optimizing shelf-life is essential for creating food the desired shelf-life of the baked Cupcake in three formulations shown in Figure 7. The researcher determined the shelf–life of the Sweet Potato and Malunggay Cupcake every day, through observation using the researcher's sensory abilities and observed the changes of the finished product from time to time. The findings showed that the qualities remained the same until fourth day of storage. The color, taste, aroma, texture, appearance of all formulations was stable. Changes occurred on the 5th day. Visible changes occurred when the F1, F2, and F3 became moist and it has already evidence of the growth of molds. On the 6th day, molds increased in all samples and it indicated that the Cupcakes were already unsafe for human consumption.

The present study used sensory evaluation and ocular observation to get of the finished product especially if it will be used commercially so that the consumer can easily identify its expiration date. The study observed the shelf-life of Sweet Potato and Malunggay Cupcakes. On the other hand, shelf-life varies between the recipes when at room temperature and refrigerated. Hence, it was evident that the shelf-life of the three formulations of Cupcake was safe up to four days for safe human consumption.

Economic Desirability of the Sweet Potato *(Ipomoea batatas*) and Malunggay (*Moringa oleifera)* Cupcake

The economic desirability of the sweet potato and malunggay Cupcake as an alternative healthy snack is a multifaceted concept that encompasses various aspects of consumer demand, market potential, cost-effectiveness, and societal benefits. Utilizing sweet potato and malunggay promotes food sustainability, improve dietary quality and promote health in a variety of populations, especially in areas where there are nutritional shortages.

Economic desirability was making use of resources, inputs, or processes; increasing the value of these inputs, and then generating cost saving for public system environment (Struik et al.,2017). On the study of Dela Cruz (2023), used sweet potato and malunggay in producing a Pandesal as a healthy snack. The raw materials used was available in the community and were converted to sweet potato flour and malunggay powder. Incorporating sweet potato and malunggay into Pandesal significantly enhances its nutritional profile, making it a healthier alternative to traditional Pandesal while providing essential nutrients and health benefits. Similarly, the present study used the available resources in the community like sweet potato and malunggay by converting it to sweet potato flour and malunggay powder. These ingredients will serve as the main ingredients in producing Cupcake that will benefit the community by consuming healthy food or snacks. The finished product can be an alternative source of income in the community and entrepreneurs. This will open job oppurtunities in the community as well. Therefore, sweet potato and malunggay Cupcake has positive market potential among health-conscious and possible consumers that can be an alternative healthy snack and can be a source of income in the community as well.

Results on market potential were supported by Flores et al. (2018) who underpinned that the Philippines Sweet Potato is the third most important crop after rice and maize. The agriculture department classifies Sweet Potatoes as a high-value crop and encourages investment and consumption as they are believed to play a major role in food sufficiency.

Conclusions

Sweet potato and malunggay contained essential nutrients that nourished the body to become healthy. Thus, consuming sweet potato and malunggay Cupcake helped in improving one's health and avoid from various diseases. Additionally, there were specific procedures to be followed in the production of sweet potato flour and malunggay powder. Following correctly the procedures saved time, effort and ensured quality sweet potato flour and malunggay powder. Furthermore, the best formulation using sweet potato flour and malunggay powder as an alternative ingredient in making Cupcake was Formulation 3 with a 1 cup of sweet potato flour, 2 teaspoons of malunggay powder, and 1 cup of all-purpose flour. Due to the equal amount of sweet potato flour and all-purpose flour it makes the Cupcake firm, uniform size and shape that preferred by the respondents. Also, based from the different formulations evaluated by the respondents of this study, Formulation 3 was the highest score and it was highly acceptable to the likings of the respondents. Both Formulation 2 and Formulation 1 got moderately acceptable to the likings of the respondents. All the three formulations lasted for four days for safe human consumption at room temperature. After five days, changes were occurred and there was already evidenced growth of molds which was not safe for human consumption. Additionally, the research indicated that the utilization of sweet potato and malunggay Cupcake as an alternative healthy snack added unique healthy twist to the common Cupcake. Focusing on the marketability of sweet potato and malunggay, aligned well with the growing demand for health-conscious consumers. Researcher used sweet potato and malunggay as the available resources and raw materials in the community. Sweet potato and malunggay were converted into sweet potato flour and malunggay powder. Sweet potato flour and malunggay powder served as the main ingredients in producing a Cupcake. This product benefited the community by consuming healthy food or snack. It also served as an alternative source of income in the community, entrepreneurs, and offered job opportunity to the community as well. Since there are raw materials were available in the community, many food products can be developed that will greatly help the people in the community.

Recommendations

he study recommends a complete nutritional analysis and testing to determine the vitamins and minerals content or nutritive value, per serving of the sweet potato and malunggay Cupcake based on the determined highly acceptable proportion. Considerably, the evident importance of relevant research and development studies on product enhancement is highly encouraged. Then, the procedures given must be followed properly to avoid spoilage of raw materials and to achieved the desired quality. Dehydration of sweet potato using oven dryer or dehydrator can be used as an alternative way of drying sweet potato to save time and effort than sun-drying. On

the other hand, sun-drying the malunggay leaves under the heat of the sun can be an alternative way of drying the malunggay leaves if electricity is unavailable. Additionally, the absence of gluten in the sweet potato and malunggay Cupcake that act as a binder hinders from making the cupcake firm, uniform size and shape. The future researcher can add or modified other ingredients that would improve the consistency of the batter mixture of sweet potato and malunggay Cupcake. Further study is recommended to explore microbial analysis of the Cupcake. Moreover, all of the proportions were found moderately acceptable to highly acceptable to the respondents. A continuous research and development of this study is highly recommended to achieve the highest score in terms of acceptability. Other researchers can utilize the finished product and make it more palatable and commercially profitable. Furthermore, to achieved the quality standard of the sweet potato and malunggay Cupcake and ensured health and safety of consumers, series of shelf-life verification should be conducted to determine the number of days required to be stored at room temperature. Also, to avoid spoilage and extend the shelf-life of the Cupcake, the researcher suggests to put it in the fridge to prolong the shelf-life.

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References

Abioye, V. F. & Aka, M. O. (2015). Proximate Composition and Sensory Properties of Moringa Fortified Maize-Ogi. Journal of Nutrition & Food https://www.researchgate.net/profile/Victoria

Abou-Zaid, A. A. & Nadir, A.S. (2014). Quality Evaluation of Nutritious Chocolate and Halawa Tahinia Produced with Moringa (*Moringa oleifera*) LeavesPowderhttps://www.curresweb.com/mejas/mejas/2014/1007-1015.pdf RetrievedApril 17, 2023.

Akajiaku, L.O., Kabuo, N. O., & Omeire, G. (2018). Production and Evaluation of *Moringa oleifera* Leaves Powder Enriched Yogurt. Nutrition and Food Toxicology, 459– 466. https://www.researchgate.net/publication/332865088

Alam, M. K. (2021). A comprehensive review of sweet potato (*Ipomoea batatas [L.] Lam*): Revisiting the associated health benefits, Trends in Food Science & Technology, Volume 115, Pages 512-529, ISSN 0924- 2244.https://www.sciencedirect.com/article/pii/S0924224421004398

Alano, R. SB. (2023). Dragon Fruit Peel Candy: A Source of Income, Unpublished Master's Thesis, Naga College Foundation, Inc., Naga City.

Aliteg, A. M. (2015). Use and Acceptability of Kamote, Saluyot, Malunggay, and Cacao in the Preparation of Chiffon Cake. https://www.researchgate.net/publication/344382096_Sensory_Evaluation_Acceptability_and_Proximate_Analysis_of_Bambusa_blumeana_as_Bamboo_Shoot_Cupcake_A_Product_Development

Aller, M. C., Villarin, M. D., & Pascual, P. R. L. (2015). Product Development of malunggay (*Moringa oleifera*) and Sweet potato (*Ipomea batatas*) for Pastry and Fillings.

https://link.springer.com/article/10.7603/s40934-015- 0005-1#preview, Retrieved February 24, 2023.

Ananias, N. K. (2015). Antioxidant activities, phytochemical, and micronutrients analysis of African Moringa (*Moringa ovalifolia*). Ph.D. Thesis, University of Namibia

Angeles, M. B. (2018). "Siling Labuyo (*Capsicum Frutescence*)-Flavored Cakes and Cookies. Unpublished Master's Thesis. Naga College Foundation (NCF), Naga City.

Asian Pacific Journal of Cancer Prevention (2014). Health benefits of *Moringa oleifera*. http://dx.doi.org/10.7314/APJCP.2014.15.20.8571

Babayeju, A., Gbadebo, C., Obalowu, M., Otunola, G. A., & Kayode, R. (2014) Comparison of Organoleptic properties of egusi and eforiro soup blends produced with Moringa and spinach leaves. Food Sci. Qual. Manag. 2014; 28:15 18.

Bach, D., Bedin, A. C., Lacerda, L. G., Nogueira, A., & Demiate, I. M. (2021). Sweet Potato (*Ipomoea batatas L.*): a Versatile Raw Material for the Food Industry https://www.semanticscholar.org/paper/Sweet-Potato-(Ipomoea-batatas-L.)%3A-a-Versatile-Raw-

Bantog, A. J. (2015). "Coco-Pili Bar: A Developmental Study". Unpublished Master's Thesis. Bicol University, Legazpi, City.

Beatriz, M. L. (2019). *Cocus Nucifera* Cupcake: Insights and Implications for a Healthier and Happier Mother Earth. Unpublished Master's Thesis, Naga College Foundation, Inc., Naga City.

Bhuyan, S., Mishra, S., Mallick, S. N., Biswal, S., & Chauhan, B. S. (2022). Sweet potato: Its Nutritional Factor andHealthbenefitshttps://www.researchgate.net/publication

Biao, Y., Chen, X., Wang, S., Chen, G., McClements, D. J., & Zhao, L. (2019). Impact of mushroom (*Pleurotus eryngii*) flour upon quality attributes of wheat dough and functional cookies-baked products. Food Science and Nutrition, 8(1), 361–370. https://doi.org/10.1002/fsn3.1315 Retrieved

Bonsi, E. A., Plahar, W. A., & Zabawa, R. (2014). Nutritional enhancement of Ghanaian weaning foods using the orange flesh sweetpotato (*Ipomea batatas*). African Journal of Food, Agriculture, Nutrition and Development, 14(5), 2036–2056. Retrieved April 14, 2023.

Burce, C. B. (2016). Black Plum Seeds as Main Ingredients for Coffee, Unpublished Master's Thesis, Naga College Foundation, Inc., Naga City

Butke, W., Santos, M. M., Romeiro, d. A., Luane, A., d. S., Elisvania F., & Novello, D. (2018). Addition of pumpkin skin flour in pizza changes the physicochemical and sensory acceptability of children. International Journal of Development Research, 8(August),2140921415.https://www.researchgate.net/profile/NovelloD/pu blication/326811997

Calubaquib, J. B. & Suyu, M. C. (2020). Proximate Composition of Fortified Filipino Snacks for Picky Eaters Calubaquib, Jhoanna and Suyu, Milagros C., Proximate Composition of Fortified Filipino

Snacks for Picky Eaters. Indian Journal of Science and Technology January 2020, Vol 13(01), 61 – 69 Doi: 10.17485/ijst/2020/v13I01/149050, Available at SSRN: https://ssrn.com/abstract=4258809

Castro, C. S. (2019). Innovative Recipes from Squash (*Cucurbita Maxima Duchesne*) For A Home-School Income Generating Project. Unpublished Master's Thesis, Naga College Foundation, Inc., Naga City.

Cristuta, M. A., Berongan, J. E., Radam, M. D., Saladaga, M. S., & Miranda, M. (2019). Nutrition and Academic Achievement of Filipino Learners: A Literature Review (Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4|Issue-1, https://www.ijtsrd.com/papers/ijtsrd29733.pdf 0

Croation Journal Food Science Technology (2014). Effect of *Moringa oleifera* flower fortifaction on the nutritional quality and sensory properties of weaning food https://doi.org/10.7314/APJCP.2014.15.20.857

Dahl, W. J. & Stewart, M. L. (2015). Position of the Academy of Nutrition and Dietetics: Health Implications of Dietary Fiber. https://www.sciencedirect.com/science/article/abs/pii/S221226721501386 6

de Brito, M. d. R., Morato, P. N., & Benedetti, S. (2019). Elaboration of muffin banana gluten free and addition of the eggplant flour. REBRAPA – Brazilian Journal of Food Research. 019 Vol.10 No.4 pp.62-72 ref.18. http://222.cabdirect.or./cabdirect/abstract/20219912367, Retrieved

de Carvalho, I., Stuart. T, Tivana, L. D., Granfeldt, Y. & Dejmek, P. (2014). Improved Energy and Sensory Properties of Instant Porridge Made from a Roasted Mixture of Grated Orange-Fleshed Sweet Potatoes and Flour Made from Shredded Sun-Dried Cassava. Food and Nutrition Sciences,05,1430-1439. doi: 10.4236/fns.2014.514156

Dela Cruz, L. O. (2023). Sweet potato (*Ipomoea batatas*) and Malunggay (*Moringa oleifera*) Pandesal. Camarines Norte State College https://onlineservices.ipophil.gov.ph/patgazette/IPASJournal/V26N15_UM_1st.pdf

Department of Education Order No. 13, series 2017, Policy and Guidelines on Healthy Food and Beverage choices in schools and in DepEd Offices. https://www.deped.gov.ph/wp-content/uploads/2017/03/DO_s2017_013.pdf Retrieved August 20, 2024.

Department of Science and Technology-Food and Nutrition Research Institute (Philippine Food Composition Table Online Database (PhilFCT) (2019). Proximates (Food Composition per 100g Edible Portion) https://i.fnri.dost.gov.ph/fct/library/report/3179 RetrievedMarch 2, 2023.

Echo Research Community (2021). The Nutrient Content of Moringa Oleifera Leaves, https://www.echocommunity.org/en/resources/

El-Tayeb, T., Abdelhady, H. M. & Salem, Emad A. (2015). Chemical, Physical, and Sensory properties of Sweet potato cake. Egyptian Journal of Agricultural Research, 93 (1), 101-115. doi: 10.21608/ejar. 2015.152780. https://ejar.journals.ekb.eg/article_152780_62fd2d4c2e0fe47cc2c8121647 e3e3d9.pdf

Emelike, N. J., Tamuno E., & Caroline O. (2016). Effect of Drying Techniques of Moringa Leaf on the Quality of Chin-Chin Enriched with Moringa Leaf Powder. IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR JESTFT). 2016; 10(4):65- 70

European Journal of Pharmaceutical and Medical research (2016). Review on Nutritional and harmacological potencies of Moringa Oliefera.ejpmr,2016,3(1),150-155

Fider, C. P., Ignacio, M. C. B., Somera, M. H., Tabu, L. P., & Montesines, A. G. L. (2016). Development of affordable Vegetable-based snack food recipes for grade school and high school students

Flores, E. D., & Dela Cruz, R. S.M. (2017). Value chain improvement of fresh sweet potato through mechanical harvester Agric. Eng. Int.: CIJR J. 19 159-196 Retrieved February 9, 2023.

Flores, E. D., Dela Cruz, R. S.M. & Antolin, M. C. R. (2018). Assessment of the postharvest handling systems and fresh sweet potato *Asian J.* Postharvest and Mechanization 1(2) 43-56. Retrieved February 7, 2023.

Food and Nutrition Institute. Acta Horticulturae (2017). Efficacy of Malunggay (*Moringa oleifera*) leaves in improving the iron and vitamins A and B status of Filipino schoolchildren. https://www.researchgate.net/publication/316834338

Haile, A., & Getahun, D. (2018). Evaluation of nutritional and anti- nutrition factors of orange-fleshed sweet potato and haricot bean blended mashed food for pre-school children: The case of Dale. Food Science and Technology, 6(1), 10–19. 10.13189/fst.2018.060102

Hua, J., Haixin, Z., Hongtao, L., & Yunchao, L. (2015). Analysis on the Nutrition Composition and Antioxidant Activity of Different Types of SweetPotatoCultivarshttps://www.scirp.org/journal/paperinformation.aspx ?paperid=53 370 Retrieved April 11, 2023.

Imperial, R. M. (2014). Formulation of instant adlay (*Corx Larcryma Jobi L*) nutrimeal, Unpublished Master's Thesis, Bicol State College of Applied Sciences and Technology, Naga City.

Journal of Food Processing and Preservation (2014). Effect of Moringa germinated tigernut and Moringa flour blends on the quality of wheat-based bread Food Process. Preserv.2014;38:721-727.,

Kolawole, F. L., Akinwande, B. A., Beatrice I. O., & Ade-Omowaye, B. I. O. (2018). Physicochemical properties of novel cookies produced from orange-fleshed sweet potato cookies enriched with sclerotium of edible mushroom (*Pleurotus tuberregium*). Journal of the Saudi Society of Agricultural Sciences, 1920–5. 10.1016/j.jssas.2018.09.001 Retrieved March 18, 2023.

Krishnan, L. G., Doriya, K., & Kumar, D. S. (2016). *Moringa oleifera*:A review on nutritive importance and its medicinal applicationhttps://www.sciencedirect.com/science/article/pii/S2213453016 30032,

Laelago, T., Haile, A., & Fedaku, T. (2015). Production & Quality Evaluation of Cookies Enriched with β-Carotene by Blending Orange- Fleshed Sweet Potato and Wheat flours for Alleviation of Nutritional Insecurity http://article.sapub.org/10.5923.j.food.20150505.05.html

Lalugan, Elizabeth B. (2015). "Indian mango (*Mangifera Indica*) Wine. Unpublished Master's Thesis. Bicol University, Legazpi City.

Mitiku, D. H., Abera, S., Busse, N., & Abera, T. (2018). Physico-chemical characteristics and sensory evaluation of wheat bread partially substituted with sweet potato (*Ipomoea batatas L.*) flour. British Food Journal, 120(8), 1764– 1775.https://doi.org/10.1108/BFJ-01-2018- 0015

Mohanraj, R. & Sivasankar, S. (2014). Sweet Potato (*Ipomoea batatas [L.] Lam*)-A Valuable Medicinal Food: A Review https://www.liebertpub.com/doi/10.1089/jmf.2013.2818

National Nutritional Council (2021). The Wonders of Malunggay and its Beneficial EffectstoLactation.https://www.nnc.gov.ph/regionaloffices/mindanao/regio n-ix- the-wonders-of-malunggay-and-its- beneficial-effects-to- lactation

Ohizua, E. R., Idowu, A., Abiodun A. ,Sobukola, M. A., Olajide P, Ishola, Raphael O., Ayansina, Simeon O., Tolulope O., & Falomo, A. (2016). Nutrient composition, functional, and pasting properties of unripe cooking banana, pigeon pea, and sweet potato flour blends, https://onlinelibrary.wiley.com/doi/epdf/10.1002/fsn3.455, Retrieved February 28, 2023.

Olubunmi, A. A., Oyeyemi, I., Laniran, A., Mojirade, A., Ojubanire B. A. & Kehinde, O. E. (2017). Development, evaluation and sensory quality of orange fleshed sweet potato (*Ipomoea batatas* Lam) extruded pasta products. Croatian Journal of Food Technology, Biotechnology and Nutrition, 12(1–2), 83– 89

Palada, M. C. (2022). The Nutritional and Health Benefits of Moringa (Malunggay). https://cpu.edu.ph/news/the-nutritional-and-health-benefits- ofmoringamalunggay Retrieved February 6, 2023.

Pati, K. V., Singh, C., Bahadar, B., Venkatraman, & Nedunchezhiyan, M. (2021). Biofortification in sweet potato forhealthandnutritionsecurity.https://www.researchgate.net/publication/35 6718545_Biofortification_in_Sweet_Potato_for_Health_and_Nutrition_Secu rity/link/62 85de8c50c4566fc2745e8d/download

Ramirez, R. M. (2021). Technology Process and Standardization of Sweet Potato (*Ipomoea Batatas Linn.)* Pie. Natural Volatiles & Essential Oils 2021, 8(6),28702884.https://www.nveo.org/index.php/journal/article/view/3992 /3288

Refardo, N. B., Gonzales, J. P., Maquiling, L. G., & Jao, J. H. (2023). Acceptability of Sweet Potato (*Ipomoea batatas*) flour and Toasted Rice (*Orayza sativa*) Powder as Base Ingredients in Making Polvoron. https://www.researchgate.net/publication/370117310 Retrieved

Sahay, S., Yadav, U., & Srinivasamurthy, S. (2017). Potential of *Moringa oleifera* as a functional food ingredient: A review. https://researchgate.net/publication/319760480_Potential_of_Moringa_ole ifera_as_a_functional_food_ingredient_A_review

Sahu, N. & Lakra, A. (2020). Processing of moringa leaves (Nutrients Source) for human consumption https://www.phytojournal.com/archives/2020/vol9issue5/PartH/9-4-436- 492.pdf Sarte, D. C. (2016). Food products from the banana pith (*Musaceae Zingberales*), Unpublished Master's Thesis, Bicol State College of Applied Sciences and Technology, Naga City.

Senthilkumar, R., Muragod, P.P., & Muruli, N.V. (2020). Nutrient Analysis of Sweet Potato and Its Health Benefits. https://pdfs.semanticscholar.org/85a2/2c5b8b6b7b938b1f05958bdb956a6 bc1a64b.pdf Retrieved March 2, 2024.

Soverano, J. R. SR. (2016). Lubas (*Spondias Pinnata*) Wine, Unpublished Master's Thesis, Naga College Foundation, Inc., Naga City.

Srinivasamurthy, S., Yadav, U., Sahay, S., & Singh, A. (2017) Development of muffin by incorporation of dried *Moringa oleifera* (Drumstick) leaf powder with enhanced micronutrient content. International journal of Food Science and Nutrition. 2017; 2(4):173-178.

Stadtlander, T. & Becker, K. (2017). Proximate Composition, Amino and Fatty Acid Profiles and Element Compositions of Four Different Moringa Species. Journal of Agricultural Science. 2017, 9(7). doi: 10.5539/jas. v9n7p46.

Sustainable Development Goals Goal 2: Zero Hunger (Retrieved February 4, 2023). https://www.un.org/sustainabledevelopment/hunger/.

Tamayo, F. A. & Tamayo, P. A. A. (2020). Sensory Evaluation, Acceptability and Proximate Analysis of *Bambusa blumeana* as Bamboo Shoot Cupcake: A Product Development. 11(September), 33–43. https://www.researchgate.net/publication/344382096

Tan, S.L. (2015). Sweetpotato-*Ipomomea batatas* A great health food. http://eprints.utar.edu.my/1974/1/Sweetpotato_-_Ipomoea_batatas_- _a_great_health_food.pdf

The Pharma Innovation Journal (2019). Nutritional Quality analysis of dry Moringa powder varity-PKM-1. The Pharma Innovation Journal;8(7):95-98

Toshi, N. (2023), Moringa Leaves Health Benefits. https://pharmeasy.in/blog/16-health- benefits-of-moringa-leaves

United States Department of Agriculture National Agricultural Library (2015). Roots and Tuber Crops as Functional Foods: A Review on Phytochemical Constituents and Their Potential Health Benefits. https://www.hindawi.com/journals/ijfs/2016/3631647/tab4/

Zaldariaga, M. J. S., Chavez, G. B., Chaves, R. B., Ofalla, M. N., & Castor, Teresita L. (2022). The General Acceptability of Chili Sweet Potato Pie. https://scimatic.org/storage/journals/11/pdfs/871.pdf,