

Sensorial Evaluation of Bamboo Shoot (*Bambusa Merrilliana*) Flour as Pasta

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ABSTRACT: The study aimed to investigate the acceptability of bamboo shoot pasta in Spaghetti, Carbonara, and Lasagna dishes. The bamboo shoot flour as pasta was evaluated in terms of appearance, aroma, taste, and texture by the 40 respondents composed of children, teenagers, adults and food experts

The study used a quantitative-descriptive experimental design, utilized the statistical tools of mean, standard deviation and One Way between Groups Analysis of Variance. The results showed that the bamboo shoot pasta in three pasta recipes received high ratings across all evaluated criteria, with taste being the highest average in all recipes namely the Spaghetti (4.40), Carbonara (4.54) and Lasagna (4.59). The study found that the bamboo shoot pasta was highly acceptable and comparable to commercial pasta products. The study also found that the bamboo shoot pasta was highly acceptable in terms of aroma, with most respondents describing it as having a desirable aroma. The shelf life of the fresh pasta in a closed container can last for at least 3 days in contrary to open space (bilao) stayed for 2 days and eventually dried but there is no sign of spoilage or molds until the 14th day of observation.

Overall, the study suggests that bamboo shoot pasta can be a viable alternative to traditional wheat flour-based pasta products, offering a more sustainable and available option. The implications of this study are significant, as it highlights the potential of bamboo shoot flour as pasta as a sustainable food source and promotes local food production. The study also contributes to the development of innovative and local food products that can benefit consumers, community and the environment.

KEYWORD: Bamboo Shoot Flour, Pasta, *Bambusa merrilliana*, Alternative Flour, Composite flour

INTRODUCTION

The scarcity of food most especially cultivated crops become one of the causes of lack of access to food and nutrition security around the world. One of the pillars for Sustainable Development Goals set by the United Nation is the SDG 2 which is achieving zero hunger around the world, providing more accessible raw ingredients, nutritious food and balance distribution of crops to all the people. The changes of economic stability of a country became the barrier of achieving a self - sufficient raw ingredients for food and some of the crops grown to a specific environment making it hard to compete in the global market for the supplies. It is a vital to seek an alternative raw materials/ingredients that are highly accessible to the country's available resources to supply for consumption among their citizens as prescribed in the SDG 12 in ensuring a sustainable consumption and production. Developing nutritious food from producers which are locally available in the market would combat or address issues on malnutrition (Aggabao 2017), in consonance to address more accessible food sources while making partners to locality as stated in SDG 17 to have a partnership in attaining the goals.

In this connection, Bamboo shoot is one of the vegetables crops growing in the South East Asia. Dishes around the region that the main ingredients are a Bamboo shoots are seen to different South East Asia countries cuisine like in the Philippines, wherein it is widely known for its name Rabong or Labong. Researches show different nutrients that bamboo shoots provide like high content protein, minerals, amino acids, fiber, carbohydrates and low in fats and sugar. This vegetable crops are not a cultivated crops compare to other vegetable crops intended for planting because Bamboo is a perennial plant that able to produce its off spring through shoots. According to the study of Aggabao (2017) stated that the shoots are free from residual toxicity and grow without the application of fertilizers. This type of vegetable crop is produced by a bamboo new offspring and it is not commercially grown agricultural crops making it safe from hazardous chemicals used in agricultural crops that are commercially grown and for its rapid harvest and quality.

On the other hand, flour comes from the different grains, legumes, nuts and root crops. The use of flour in breads, cakes, pies and other foods reflects not only people's physical needs (food for survival), but also their inner desire for joy (New World Encyclopedia 2021). According to Blanchfield (2002) stated that various materials typically are added to the flour, including bleaching agents, oxidizing agents, vitamins, minerals, leavening agents, and salt in producing different type of products made out

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of flour to increase the taste, nutritional value and quality of the different products. Wheat flour is highly commercialized type of flour that is used around the world, but this type of grain is not available here in the Philippines as an agricultural crop as the environment to thrive this cereal is not the same to the climate that we have in the country, this lead for an export transaction to other supplier countries that thrive and cultivate this type of grain making it to be expensive. Different researcher tends to study different crops as an alternative for wheat flour, most of the crops are commercially produce agricultural crops wherein we cannot deny that this crop has been fed up of fertilizers and chemicals that may affect the quality and nutritive values of the crops.

One of a products that comes from flour is making a pasta, this is a widely accepted type of food that the different age group likes from the spaghetti that favored the taste of children up to different preparation of pasta sauces favored to the taste of the consumers. In addition to that, pasta is a trendy food with a wide range of acceptability in many population groups including fitness enthusiasts (Goni et al. 2003). According to Nilusha et al. (2019) stated that increased demand by growing number of health-conscious consumers for healthy foods has shifted the interest of researchers and food manufacturers to develop pasta products rich in minerals, vitamins and fiber. Numerous improvements in the food industry and high consumer demand for the pasta products have directed the development of pasta products with non-conventional ingredients (Ficco et al. 2016). This provides as the main focal point of decentering the reliance of grains in the production of pasta and introducing vegetables and root crops as substitution. The appeal and the incorporation of a new ingredient that is highly available to the local market and resources to pasta production for enhancement of reliance and nutritive factors.

The potential of bamboo shoots flour as a pasta is indeed the aligned course of subject to further study its sensorial and acceptability to the different age group. The gaps paved way the concept to introduce the locally available crops that is not grown commercial but regionally available in the Philippines from backyard and alongside streams, bamboo thrives and produces shoots that are edible and prepare as vegetables to many dishes. This innovative product, once produced will benefit bamboo owners and business people to introduce innovated pasta products to the community.

The study was conducted to introduce new concept of preparing bamboo shoots for the children that usually do not like bamboo shoot preparation and dishes to enjoy the extra nutritive attributes of the bamboo shoot. The locally growing plants/crops can benefit the farmers or bamboo owners for potential profit to the pasta production integrating bamboo shoots, considering the availability of the crops in the province. The bamboo shoot pasta is a promising development that can give variety of bamboo shoots preparation on a widely accepted pasta dishes and open opportunity for profit of the local growers or owners considering the abundance of bamboo shoots in the province.

Pasta

Pasta is the Italian word for "dough." Extruded dishes made in the Italian cuisine, such as lasagna and spaghetti, are commonly referred to as pasta. Pasta is a sort of historic food that is defined as dough that has been stamped or extruded into various forms for cooking (Sissons et al 2008, Adegunwa et al. 2012). In 2014, the global production of pasta amounted to over 14 million tons, with Italy being the primary producer and global leader in pasta consumption. Because it is more convenient, more palatable, and has a longer shelf life than other bakery goods like breads and buns, pasta is consumed widely over the world. (IPO 2014, Bustos et al. 2015).

Origin of Pasta

According to Share Pasta (2018), the history of pasta is dated by a famous legends that states Marco Polo introduced pasta to Italy after his tour of the early East in the late 13th century. Pasta can be traced back as early as the 4th century B.C., when an Etruscan tomb depicted a group of people preparing pasta. As early as 3000 B.C., the Chinese were preparing noodle-like dishes. According to Greek mythology, the Greek god Vulcan created a method for making dough strings, which became the first spaghetti. Pasta came to the New World via the English, who discovered it while travelling Italy. Colonists brought to America the English habit of boiling noodles for at least half an hour before coating them with cream sauce. Thomas Jefferson, the third President of the United States of America, is credited for introducing the first macaroni machine to America in 1789, when he returned home from serving as ambassador to France. A Frenchman created the first industrial pasta mill in America in Brooklyn in 1848, spreading his spaghetti strands on the roof to dry in the sun. Pasta production grew in the 19th century, and pasta makers arose up across the nation. Today, pasta remains a family favorite and is produced in countless shapes and sizes, with wheat, veggie, and gluten-free options all available. Continues exploration of enrich and fortified pasta are studied to improve the nutritive content of the pasta as the consumer become health-conscious seeking for a healthy option.

Different Types of Pasta and Sauce/Preparation Recommended

According to My food book blog (2023), discover several pasta varieties and a plethora of recipes to pair them with. Pasta is a popular and adaptable cuisine that can be used in many different dishes. In Australia, pasta dishes rank third in popularity among evening meals, only surpassed by steak and vegetables and roasts. It makes pasta as the building block for countless flavor combinations, and there are many varieties of pasta shapes that are ideal for varying recipes. It also means that experimenting with different pasta recipes can produce a variation of taste and source of nutrition.

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1. **Spaghetti.** With a great texture and its long thin cylindrical shape makes it easy to chew and entertaining to twirl. The most common pasta meals are those that use red sauce or spaghetti Bolognese. It is also arguably the most famous pasta.



Figure 1. Spaghetti Pasta (Source: Jessica Gavin)

2. **Fettuccine.** Instead of being thin and spherical, fettuccine is flat, wide, and lengthy. Cheese sauce goes well with it. This is the ideal noodle to toss into a creamy foundation for a bacon carbonara or chicken alfredo.



Figure 2. Fettuccine Pasta (Source: Sellhimvs)

3. **Linguine.** The greatest qualities of fettuccine and spaghetti are combined to create linguine. It is similar in width to spaghetti but flatter like fettuccine, and it pairs well with a variety of sauces.



Figure 3. Linguine Pasta (Source: Pasta Marella)

4. **Tube pasta.** Tubular pasta's hollow form makes it ideal for sopping up loads of your preferred sauce. Pastitsio and pasta bakes are popular uses for short tube pasta.



Figure 4. Tube Pasta (Source: Ricardo cuisine)

5. **Penne.** These noodles mimic the point of a fountain pen since they are typically 4-5 cm long and cut at an angle. The hollow is around the size of a pencil. It can be ridged and smooth, or "penne rigate," which has a nice texture and works well to retain additional sauce. Penne works nicely in baked pasta recipes since it cooks through quickly and has the ideal bite size.



Figure 5. Penne Pasta (Source: Freepik)

6. **Rigatoni.** Large tube noodles, rigatoni are cut short and straight and have a wider width than penne. It pairs well with Bolognese sauce because of the ridges that run the length of it, which help it pick up and bind to the sauce. Accompany with garlic bread for extra flavor.



Figure 6. Rigatoni Pasta (Source: Tutonis Flour shop)

7. **Macaroni.** It is a little pasta with a narrow tube that is short in length. Elbow macaroni is the name given to it when it occasionally bends. Macaroni is well known for its use in the decadent and flavorful mac and cheese, a traditional comfort food or side dish.



Figure 7. Macaroni Pasta (Source: India mart)

8. **Lasagna.** It is the name for the large, flat sheets of pasta. Lasagna is a traditional layered dish made with pasta, Bolognese sauce, and bechamel. Lasagna sheets can be used either fresh or dried, and occasionally the edges have a wavy appearance.



Figure 8. Lasagna pasta (Source: Grocery shop online)

9. **Farfalle.** Since it resembles a tiny bowtie with a frilled edge, this pasta is also referred to as bowtie pasta. Because of the crinkle where it comes together in the center, it works great for holding sauce.



Figure 9. Farfalle Pasta (Source: Create Vista)

10. **Rotini or Fusilli.** This spiral-shaped noodle is also known as fusilli or rotini. Particularly for small children who enjoy eating with their hands, they are a lot of fun to bite into and have a look like tiny corkscrews. In the recipe for Tuna, Tomato, and Mozzarella Bake, this pasta with a creamy texture is excellent.



Figure 10. Rotini or Fusilli Pasta (Source: Samsung Food)

11. **Shells.** Seashells with rounded edges and an open appearance are what pasta shells resemble. They are available in a variety of sizes, ranging from thimble-sized to hand-palm-sized. With their larger sizes ideal for stuffing with your favorite ingredients, the smaller ones are fantastic for fresh sauces or bakes. Ricotta cheese, which is creamy, is frequently combined with other ingredients to fill them, like in this recipe for stuffed shells that include pumpkin, spinach, and ricotta.



Figure 11. Shells Pasta (Source: Replenish online)

12. **Gnocchi.** Made from potato and wheat, gnocchi are tiny pasta dumplings. Because they are sold fresher than most pasta, they are gorgeous, round, and pillowy, and they can cook in as little as two minutes.



Figure 12. Gnocchi Pasta (Source: Source good food)

13. **Orecchiette.** Since orecchiette's round, dimpled shape resembles an ear, the word literally translates to "small ears." Their texture when cooked is softer in the center and slightly chewy around the outside. Their cupped form handles spaghetti sauce and other components effectively.



Figure 13. Orecchiette Pasta (Source: Nuts)

14. **Risoni.** These little pastas, known as orzo in North America, resemble small grains of rice. They are popular in soups and stews and cook rapidly.



Figure 14. Risoni Pasta (Source: Essential Ingredients)

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Composite Flour Used in Pasta Making

Several researches of flour can be used when making pasta. Each affects the color, flavor, and texture in a different manner (Fuad et al. 2010). Different flours create a distinctive pasta product that makes a diverse types and function that a flour can contribute on making the product.

1. Cassava Flour. It comes from the root vegetable cassava. It can serve as a gluten-free substitute for wheat flour in bread, pasta, and other foods. Many people consider it the most similar gluten-free alternative to wheat flour in terms of taste and texture.



Figure 15. Cassava Flour (Source: Bob's Red Mill)

2. Spelt Flour. It is an old European crop which has been grown for centuries in several countries of central Europe. Marconi et al. (2002) report that *Triticum spelta* L. wheat has rheological and technological properties close to those of durum wheat. It can therefore be used to make pasta with good nutritional and sensory properties.



Figure 16. Spelt Flour (Source: Nuts.com)

3. Brown Rice Flour. It comes from brown rice grains which are high in fiber with a tan or light brown in color. This flour is usually used in making flat ribbon pasta



Figure 17. Brown Rice Flour (Source: Farmstead Food)

4. Soy Flour. It can be used to supplement protein in macaroni and to produce a quick cooking pasta product. Shogren et al. (2006) observed that spaghetti with high protein and high-lysine content can be obtained by adding up to 35% soy flour without an adverse effect on the flavor and texture



Figure 18. Soy Flour (Source: JioMart)

5. Plantain Flour. It is a gluten-free, grain-free, and paleo-compliant flour from a green plantain fruit. Plantain flour naturally contains a lot of starch. Starch binds fluids in your dishes and gives food a firmer texture suitable for making pasta.



Figure 19. Plantain Flour (Source: Laba Foods)

6. 00 Flour. It provides silky and soft pasta varieties due to its delicate texture. 00 flour has a similar protein content as whole purpose unbleached flour but with a finer texture.



Figure 20. 00 Flour (Source: Suntralis Food)

7. Potato Flour. It makes pasta with a delicious and distinctly potato-ey flavor. The dough will feel stiff when just mixed, but after resting, it gets soft and easy to roll and cut.



Figure 21. Potato Flour (Source: Mediconda Nutrients)

8. Chick Pea Flour. The use of chick pea flour in pasta solves this problem as it contains a large quantity of high-quality protein. The incorporation of chickpea flour also increased the mineral and fat contents of pasta, thus increasing the nutritional value of the product.



Figure 22. Chick Pea Flour (Source: Detoxinista)

9. Buckwheat Bran Flour. Manthey et al. (2004) found that the addition of buckwheat bran flour (up to 30%) determined a decrease of optimal cooking time of spaghetti due to physical disruption of the gluten matrix and overall low density, which provided a path for water absorption into the enriched spaghetti, which resulted in shorter cooking times.



Figure 23. Buckwheat Bran Flour (Source: niceddsm)

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10. Arrowroot Flour. It is the secret ingredient for making delicious biscuits and other pastries and as a substitute for wheat. It is both a spice and a vegetable with a variety of uses as extenders, thickeners in noodles, soup, sausages and meat products.



Figure 24. Arrowroot Flour (Source: Netmeds)

11. Banana Pseudo Stem Flour. It is a type of flour from a trunk-like part of a banana plant, used for pasta making (Dela Cruz 2024).



Figure 25. Banana Pseudo Stem Flour

12. Maize Flour. Maize flours (particle size less than 100 μm) gave pasta with higher cooking quality and heat treatment at 90°C for 2 hours improved the quality of the product with a lower cooking loss.



Figure 26. Maize flour (Source: Evergreen)

Pasta in Non-Conventional Ingredients in Terms of Fortification and Production

The increased demand for healthy foods among health-conscious customers has attracted the interest of researchers and food manufacturers in developing pasta products rich in minerals, vitamins, fiber, and low in glycemic index. Bustos et al. (2015) pointed out in their study that pasta is a great vehicle for health improvement due to its low cost, long shelf life, and widespread consumption.

In recent years, the food industry has made a continuous effort to produce newer functional pasta products filled with minerals and bioactive substances (Oliviero and Fogliano 2016). Incorporating different grains has resulted in greater dietary advantages, such as more essential amino acids, minerals, vitamins, and polyphenols. Furthermore, for particular nutrition, composite flours have been utilized to create gluten-free or low glycemic index pasta. A number of studies have examined the potential use of functional ingredients to manufacture pasta that are enhanced with dietary fiber, bran, legume flour, whey and egg white powder, millet, and other components from plants (Nilusha et al. 2019). Different research show that people are increasingly interested in using pasta as a functional food. The addition of healthy nutrients to pasta can lower its glycemic index and bring additional health advantages to consumers. Durum wheat, which provides the primary ingredient for pasta production, namely semolina, contributes only 5% to the total world production of wheat and usually sells at a higher price than the common wheat; thus, process development and product formulations to produce pasta from non-conventional ingredients are necessary to meet the demand of increasing pasta consumption. (Fuad et al. 2010).

Bamboo Shoots

Bamboo shoots are the edible shoots of the bamboo plant, which are essentially the young bamboo culms that emerge from the ground. They are a popular ingredient in many Asian dishes, prized for their unique flavor and texture (Atillo 2024). The outside of the shoots has a thick, woody texture that makes it difficult to chew, therefore they are usually peeled before eating. Asian countries make use of the bamboo shoots as a vegetable to several cuisine.

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Variety of Edible Bamboo Shoots in the Philippines

According to the previous survey of Caasi-lit et. al (2010) shows that Several bamboo species can be utilized to generate edible bamboo shoots. The table lists common and unusual bamboo species used for food. In an earlier assessment of 26 provinces, the top six most popular edible species were, in decreasing order, *Bambusa blumeana*, *Bambusa merrilliana*, *Bambusa vulgaris*, *Gigantochloa levis*, *Dendrocalamus asper*, and *Bambusa philippinensis*. Kayali, also known as *Gigantochloa atter*, is less famous for its cuisine than its relative, *G. levis*. This is most likely due to its restricted distribution to a few provinces.

Table 1. Different Variety of Bamboo Shoots in the Philippines Used as Food Source

SCIENTIFIC NAME	COMMON NAMES			PERCENT OF 26 PROVINCES (Caasi-Lit 1999)	TOTAL PROVINCE S PRESENT (SURVEY 2000-2016)
	FILIPINO/ TAGALOG	Other Names	Common		
Commonly Used as Food Source					
<i>Bambusa blumeana</i>	Kawayan-tinik	Spiny bamboo Batakan (Cebuano) Tunokon (Cebuano) Kagingking (Cebuano) Siitan (Ilokano)	88		
<i>Bambusa philippinensis</i>	Laak		11		14
<i>Bambusa vulgaris</i>	Kawayan-kiling	Marubal (Bikol) Lunas (Bisaya) Taywanak (Bisaya)	77		
<i>Bambusa vulgaris</i> cv. <i>Vittata</i>	Kawayan-dilaw	Yellow bamboo	8		
<i>Bambusa merrilliana</i>	Bayog	Bayatakan (Bisaya) Kabugawan (NSamar)	42		46
<i>Dendrocalamus asper</i>	Bukawe	Botong (Bikol, Ceb) Patong (Bisaya) Giant bamboo	31		
<i>D. latiflorus</i>	Botong	Ma-chiku (Japanese-Chinese)	8		
<i>Gigantochloa atter</i>	kayali	Kayali (Bisaya)	12		
<i>G. levis</i>	Bolo	Kawayan-tsina (Tag) Kabolian (Bikol)	39		
Not Commonly Used as Food Source					
<i>Schizostachyum brachycladum</i>	Buhong dilaw	Bagakay (Bisaya)			
<i>S. lima</i>	Anos	Sumbiling (Tagbanua)			
<i>S. lumampao</i>	Bohu	Bagakan (Bisaya)	11		
<i>Dinochloa</i> sp.	Bikal		8		

Bayog (*Bambusa merrilliana*)

Bayog is an important native bamboo species in the Philippines. It is thoroughly scattered within the country, this thrives well in low and medium lying places, particularly near bodies of water (e.g., lakeside, seashore, streams, creeks, rivers). The young shoots are covered with light grayish-green culm sheaths with very stiff, appressed, and very fine short hairs at the abaxial side. Like any other species, the adaxial side of the sheaths is always smooth and shiny. The culm sheaths are deciduous and coriaceous, very tightly embracing the shoots as shown in Figure 2 (Caasi-lit 2010).



Figure 27. Bayog (*Bambusa Merrilliana*) Shoots

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Nutritive Value of Bamboo Shoots

Many research has been undertaken on bamboo shoots from a dietary viewpoint, including nutritional quality and content, post-harvest processing, and storage (Xu et al. 2016). Fresh bamboo shoots contain 91% water, 3.5% proteins, 1.5% fiber, minerals, vitamins, and amino acids (Nirmala et al., 2011, Sood et al. 2013).

Minerals

According to the present data, bamboo shoots are an excellent source of both macro and micro elements. The macro elements consist primarily of potassium (K), phosphorus (P), sodium (Na), calcium (Ca), and magnesium (Mg), whereas the micro elements consist primarily of cobalt (Co), copper (Cu), nickel (Ni), manganese (Mn), selenium (Se), iron (Fe), and zinc (Zn) (Christian et al., 2015; Nirmala et al., 2011). In most studies, potassium was shown to be the richest macro element in diverse bamboo shoots, followed by phosphorus and magnesium. All of these macro components showed significant variance among bamboo species.

Amino Acids

According to the study of Satya et al. (2010) found that bamboo shoots can provide eight different types of amino acids that are not produced in the body. The total amino acid content of bamboo shoots varies per species, ranging from 3.01g (*Dendrocalamus brandisii*) to 3.98 g/100g fresh weight. Bamboo shoots contain arginine and tyrosine, which are normally found in small amounts in fruits and vegetables (Nirmala et al., 2018).

Protein

Bamboo shoots are also a rich source of proteins, which are very important for the growth and development, and also required for the maintenance of all biological functions of the body. Protein content in shoots of different bamboo species ranges from 19.2 to 25.8 g/100g, dry weight (Satya et al. 2012).

Multivitamin

According to Nirmala et al. (2011) stated that protein content in the shoots of different bamboo species ranges from 2.31 to 3.72 g/100 g, fresh weight. Freshly harvested bamboo shoots are also a good source of carbohydrates but with age, carbohydrate content decreases. Reported reduction of carbohydrates with increase in age, as 10-day-old shoot (2.30 g/100 g, fresh weight) had lesser carbohydrate content as compared to freshly harvested shoots (5.42 g/100 g, fresh weight). The shoots are known as a heart protective vegetable because of its high content of potassium and low content of fat. Potassium content in bamboo shoots ranges from 232 to 576 mg/100g, fresh weight. Regarding fat content, Bhatt et al. (2005) reported maximum fat content (1.00 g/100g, fresh weight) in shoots of *B. nutans* while the minimum (0.10 g/100g, fresh weight) in shoots of *D. strictus*. Other important minerals present in bamboo shoots are phosphorus, sodium, calcium, magnesium, iron and selenium. Selenium acts as a co-factor for an enzyme, glutathione peroxidase and plays an important role in growth and development. Bamboo shoots are also a good multivitamin food that can act as a foundation of good health. The vitamin C content, as determined by Nirmala et al. (2011) in the fresh shoots of various bamboo species ranges from 1.00 mg to 4.80 mg/100 g, fresh weight, on the study of Bhatt et al. (2005) reported that vitamin C content for a number of bamboo species ranging from 3.0% to 12.9%.

Cyanide Toxic Compound Removal

The toxic compound can easily be removed by various processing methods (boiling, canning, soaking, drying, and fermentation) before consumption. Traditionally, boiling bamboo shoot in an open vessel for three to four hours can reduce the toxicity through the non-enzymatic hydrolysis of taxiphyllin. Cyanide was not detected in any of the dried bamboo shoot samples tested (RAS, 2007).

Utilization of Bamboo Shoots as Food

Bamboo shoots are regarded delicacies for human eating and were once a prominent alternative food source. According to Caasi-Lit et al., 2010 stated that Bamboo shoots were used in times when no other food sources were accessible, and they are considered one of the healthiest foods up to the present because of their low-fat content and high source of dietary fiber. According to the Food and Agricultural Organization of the United Nations (FAO), 800 million people are currently food and nutrition insecure (Da Silva 2014). To fulfill rising global demand, FAO estimates that worldwide food production must be raised by 60% by 2050. However, due to water constraints, agricultural land cannot be increased (Tillman 1999). According to Scherr et al. (2012), the circumstances stimulated interest in looking for alternate food supply that may be grown in underutilized places and are resistant to stressful environmental conditions. Bamboo is one such underutilized plant with enormous potential to battle hunger and enhance health due to its nutritional and health-promoting characteristics (Chand et al., 2017). Bamboo's varied applications have earned it nicknames such as "Green Gold" and "Poor Man's Timber". Bamboo shoots, which are considered a delicacy, can be consumed fresh, fermented, or roasted, and are a common vegetable in Asia, where they are prepared in various ways. Researches shown significant study on the different fortification, substitution and nutritive enhancement of bamboo shoots to different products like muffins, cupcakes and other baked products, also to different savory dishes most especially in Asia where abundant of bamboo species grown in different areas that has edible shoots.

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MATERIALS

A. Tools and Equipment

Table 2. List of Tools and Equipment Needed in Making Bamboo Shoot Pasta

Preparatory Tools	Measuring Tools	Mixing Tools	Cutting Tools	Cooking Tools	Equipment
Kneading Table	Measuring Cups	Mixing Bowls	Knife	Gas Range	Pasta Maker Machine
Utility tray	Measuring Spoons	Mixing Spoons	Chopping Board	Frying Pan	Pasta Rolling Machine
Spatula				Cooking Pot	All-purpose powdering Grinder
Flour sifter				Ladle	
Serving Bowl					
Serving plate					

B. Ingredients

Table 3. List of Ingredients Used in Preparing the Pasta

Ingredients	Measurements Spaghetti Pasta	Carbonara Pasta	Lasagna Pasta
Bamboo Shoot Flour	125 grams	125 grams	125 grams
All -purpose Flour	313 grams	313 grams	313 grams
Bread Flour	65 grams	65 grams	65 grams
Egg	2 medium	2 medium	2 medium
Salt	6 grams	6 grams	6 grams
Oil	26 grams	26 grams	26 grams
Water	414 grams	414 grams	414 grams

Table 4. List of Ingredients Used in the Preparation of Spaghetti Recipe

Ingredients	Measurement
Bamboo Shoot Pasta	500 grams
Pork Meat	500 grams
Evaporated milk	381 grams
Pork broth	708 grams
All-purpose Cream	253 grams
Cornstarch	16 grams
Canned Mushroom	400 grams
Grated Cheese	118 grams
Liver spread	40 grams
Onion, chopped	10 grams
Garlic, chopped	10 grams
Oil	52 grams
Salt	19 grams
Pepper	1 gram
Sugar	38 grams

Table 5. List of Ingredients Used in the Preparation of Carbonara Recipe

Ingredients	Measurement
Bamboo shoot pasta	500 grams
Pork Meat	500 grams
<u>Pinoy</u> style spaghetti sauce	480 grams
Pork broth	708 grams
Hotdog	5 pieces
Banana Ketchup	646 grams
Liver spread	40 grams
Onion, chopped	10 grams
Garlic, chopped	10 grams
Oil	52 grams
Salt	19 grams
Pepper	1 gram
Sugar	38 grams

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Table 6. List of Ingredients Used in the Preparation of Lasagna Recipe

Measurements	Ingredients
Bamboo Shoot Pasta	500 grams
White Sauce	
Pork meat	250 grams
Evaporated milk	191 grams
All-Purpose cream	127 grams
Grated cheese	59 grams
Canned mushroom	200 grams
Cornstarch	8 grams
Pork broth	354 grams
Liver spread	20 grams
Onion, minced	5 grams
Garlic, minced	5 grams
Oil	26 grams
Salt	10 grams
Pepper	1 grams
Red Sauce	
Pork Meat	250 grams
<u>Pinoy</u> style spaghetti sauce	240 grams
Pork broth	354 grams
Hotdog	3 pieces
Banana Ketchup	323 grams
Liver spread	20 grams
Onion, chopped	5 grams
Garlic, chopped	5 grams
Oil	26 grams
Salt	10 grams
Pepper	1 grams
Sugar	38 grams

METHOD

In order to perform the research properly, the developmental procedures in preparing Bamboo Shoot Pasta were followed consistently. The needed tools, materials and ingredients were prepared, sun-dried, and powdered accordingly in preparation of making the product. The developmental procedure begins with harvesting/selecting, cutting, washing, boiling, sun-drying and pulverizing the bamboo shoots. After the preparation of bamboo shoot flour, the preparation of pasta shall come next and will be followed by the preparation of Spaghetti, Carbonara and Lasagna sauces. Then combining the pasta and sauce for Spaghetti and Carbonara, while Lasagna is layered with sauces and baked to serve.

A written permission to conduct the study through sensory evaluation was requested with the respondents consisting of ten (10) children, ten (10) teenagers, ten (10) adults, ten (10) food experts from Department of Agriculture Cagayan Valley Research Center (DA-CVRC) at San Felipe City of Ilagan, Isabela and TVE/TLE/HE Teachers of Isabela State University Ilagan Campus. All of the possible respondents were selected through random sampling method to cater the number of respondents. The products and sensory evaluation form was administered after authorization had been given. The researchers directly addressed directions in connection of the products' tasting and to the completion of the sensory evaluation form with the respondents. After the respondents had completed the sensory evaluation form, copies were retrieved.

The sensory evaluation was applied to determine the acceptability of bamboo shoot pasta in terms of aroma, color/appearance, taste and texture.

The criteria were used to evaluate is listed in Table 7.

Table 7. Level of Acceptability

CRITERIA
Appearance/Color
The product has attractive color
The appearance/color is suited for pasta
The appearance/color looks fresh
The product is comparable to another pasta
The product's overall appearance/color is acceptable
Aroma

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The aroma is subtle
The finished product smells good
The aroma is detectable
The ingredients' aroma is tolerable
The overall aroma is desirable
Taste
The taste of the product is acceptable
The taste is detectable
The taste of the other ingredients is present
The product is with aromatic taste
The taste of the product is exquisite
Texture
The product has a good texture
The product is al dente (firm and slightly chewy)
The texture is consistent from the surface to the inner part
The product is comparable to commercial pasta
The overall texture is highly acceptable

DISCUSSION



Figure 28. Bamboo Shoot Pasta Products

The developed Bamboo Shoot (*Bambusa merrilliana*) Flour Pasta is an innovative product aimed at providing a nutritious and alternative pasta option. It offers a unique texture and flavor while maintaining the traditional appeal of pasta dishes such as spaghetti, lasagna, and carbonara. The flour is made from bamboo shoots, which are rich in dietary fiber and essential nutrients. The pasta holds up well in cooking and has been sensorially evaluated for its taste, texture, and overall acceptability. This product is easy to prepare and offers a healthier choice for consumers.

RESULT:

To evaluate the overall response of the respondents, the following scale:

Scale	Numerical Rating	Descriptive Rating
5	4.20-5.00	Highly Acceptable
4	3.40-4.19	Moderately Acceptable
3	2.60-3.39	Acceptable
2	1.80-2.59	Slightly Acceptable
1	1.00-1.79	Not Acceptable

Product Evaluation

Table 8. Level of Acceptability of the Bamboo Shoot Flour as Pasta in Spaghetti

Evaluation Criteria	Mean	Sd	Description
Appearance/Color			
The product has attractive color	4.30	0.8533	Highly Acceptable
The appearance/color is suited for pasta	4.35	0.7355	Highly Acceptable
The appearance/color looks fresh	4.25	1.0063	Highly Acceptable
The product is comparable to another pasta	4.33	0.9167	Highly Acceptable
The product's overall appearance/color is acceptable	4.40	0.9282	Highly Acceptable

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Overall Mean	4.33	0.7682	Highly Acceptable
Aroma	Mean	Sd	Description
The aroma is subtle	4.10	0.8412	Moderately Acceptable
The finished product smells good	4.50	0.7161	Highly Acceptable
The aroma is detectable	4.23	0.8619	Highly Acceptable
The ingredients' aroma is tolerable	4.40	0.7779	Highly Acceptable
The overall aroma is desirable	4.38	0.8066	Highly Acceptable
Overall Mean	4.32	0.6896	Highly Acceptable
Taste	Mean	Sd	Description
The taste of the product is acceptable	4.20	0.8533	Highly Acceptable
The taste is detectable	4.48	0.6400	Highly Acceptable
The taste of the other ingredients is present	4.45	0.8149	Highly Acceptable
The product is with aromatic taste	4.35	0.7355	Highly Acceptable
The taste of the product is exquisite	4.50	0.6794	Highly Acceptable
Overall Mean	4.40	0.6152	Highly Acceptable
Texture	Mean	Sd	Description
The product has a good texture	4.18	1.0595	Moderately Acceptable
The product is al dente (firm and slightly chewy)	4.15	0.9213	Moderately Acceptable
The texture is consistent from the surface to the inner part	4.18	0.9578	Moderately Acceptable
The product is comparable to commercial pasta	4.10	1.0077	Moderately Acceptable
The overall texture is highly acceptable	4.30	0.9661	Highly Acceptable
Overall Mean	4.18	0.8650	Moderately Acceptable

The table presents the level of acceptability of bamboo shoot flour as pasta in Spaghetti as assessed by respondents in terms of appearance/color, aroma, taste, and texture. As shown in the table, the overall impression of the appearance/color of the bamboo shoot pasta in spaghetti is highly acceptable with an overall mean of 4.33 and a standard deviation of 0.7682. In terms of Aroma, although the subtleness of aroma was rated by described by the respondents as moderately acceptable. Most of the criteria were described as highly acceptable. With an overall mean of 4.32 and a standard deviation of 0.6896, the aroma was highly acceptable. With a mean of 4.40 and a standard deviation of 0.6152, the taste of the bamboo shoot flour as pasta in spaghetti was highly accepted by the respondents. This means that the taste is easily detectable and highly acceptable. In terms of texture, although the criterion “The overall texture is highly acceptable” was highly acceptable with a mean of 4.30 and a standard deviation of 0.9661, the other criteria were rated as moderately acceptable. Similarly, with an overall mean of 4.18, respondents perceived the product as moderately acceptable. Data reveal that the bamboo shoot pasta in spaghetti receives consistently high ratings across appearance, aroma, taste, and texture. Overall, it is perceived as highly acceptable or moderately acceptable in all evaluated criteria, with taste receiving the highest average score of 4.40 and texture the lowest of 4.18. This suggests that while the product generally meets expectations favorably, there may be slight room for improvement in texture and aroma intensity to achieve even higher ratings uniformly across all dimensions. The data is supported with the study of Aggabao (2017) wherein a utilization of different bamboo shoots variety in making macaroons is highly accepted by the respondents. It is evidently that bamboo shoots can be utilized on other product to enhance its sensorial attributes.

Table 9. Level of Acceptability of the Bamboo Shoot Flour as Pasta in Carbonara

Evaluation Criteria	Mean	Sd	Description
Appearance/Color			
The product has attractive color	4.30	0.7579	Highly Acceptable
The appearance/color is suited for pasta	4.38	0.7742	Highly Acceptable
The appearance/color looks fresh	4.35	0.8022	Highly Acceptable
The product is comparable to another pasta	4.43	0.7472	Highly Acceptable
The product's overall appearance/color is acceptable	4.48	0.6789	Highly Acceptable
Overall Mean	4.39	0.6298	Highly Acceptable
Aroma	Mean	Sd	Description
The aroma is subtle	4.38	0.7403	Highly Acceptable
The finished product smells good	4.48	0.5986	Highly Acceptable
The aroma is detectable	4.43	0.5495	Highly Acceptable
The ingredients' aroma is tolerable	4.48	0.5541	Highly Acceptable
The overall aroma is desirable	4.48	0.6400	Highly Acceptable

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Overall Mean	4.45	0.4472	Highly Acceptable
Taste	Mean	Sd	Description
The taste of the product is acceptable	4.45	0.7143	Highly Acceptable
The taste is detectable	4.53	0.6789	Highly Acceptable
The taste of the other ingredients is present	4.58	0.5495	Highly Acceptable
The product is with aromatic taste	4.45	0.6775	Highly Acceptable
The taste of the product is exquisite	4.68	0.5723	Highly Acceptable
Overall Mean	4.54	0.4605	Highly Acceptable
Texture	Mean	Sd	Description
The product has a good texture	4.43	0.6360	Highly Acceptable
The product is al dente (firm and slightly chewy)	4.35	0.7355	Highly Acceptable
The texture is consistent from the surface to the inner part	4.40	0.7089	Highly Acceptable
The product is comparable to commercial pasta	4.45	0.7828	Highly Acceptable
The overall texture is highly acceptable	4.48	0.6400	Highly Acceptable
Overall Mean	4.42	0.5707	Highly Acceptable

The table shows the level of acceptability of bamboo shoot flour used in pasta in Carbonara as assessed by respondents in terms of appearance/color, aroma, taste, and texture. As evident in the table, the bamboo shoot flour pasta in Carbonara receives consistently high ratings across appearance, aroma, taste, and texture. Regarding appearance/color, based on the evaluation of the respondents, the appearance/color of the pasta is highly acceptable with an overall mean of 4.39. This suggests that the appearance/color of the bamboo shoot flour is well suited for pasta, meeting expectations. With regard to its Aroma, the bamboo shoot flour as pasta in Carbonara is desirable and highly acceptable with a mean of 4.45 suggesting that the product meets a good and pleasant aroma. As to the Taste, respondents considered it detectable and highly acceptable with a mean of 4.54. This implies that the product is exquisite and the taste of other ingredients in the Carbonara is well-present and balanced. In terms of its texture, despite being the lowest having a mean of 4.42, the texture is still highly acceptable and well-accepted by the respondents implying that the texture is of high quality and meets expectations. Data suggest that all criteria are rated as highly acceptable, with taste receiving the highest average score of 4.54 and texture the lowest of 4.42. This indicates that the product generally meets or exceeds expectations in terms of sensory attributes. The low standard deviations across most criteria suggest a high level of agreement among evaluators, reinforcing the reliability of the ratings. Overall, this analysis underscores the product's strong performance across all evaluated dimensions in the context of a Carbonara dish. A study is conducted by Gabuyo (2020) wherein they make use of moringa and squash in making pasta most specifically carbonara, the result conforms that the level of acceptability of the pasta fortified with the locally growing crops is improved and accepted by the respondents. This is a strong implication that incorporating non-conventional crops in pasta production can positively impact the products in consonance with the stated data wherein the bamboo shoot pasta in carbonara is highly accepted.

Table 10. Level of Acceptability of the Bamboo Shoot Flour as Pasta in Lasagna

Evaluation Criteria	Mean	Sd	Description
Appearance/Color			
The product has attractive color	4.38	0.7403	Highly Acceptable
The appearance/color is suited for pasta	4.50	0.5991	Highly Acceptable
The appearance/color looks fresh	4.45	0.7494	Highly Acceptable
The product is comparable to another pasta	4.40	0.6718	Highly Acceptable
The product's overall appearance/color is acceptable	4.38	0.7403	Highly Acceptable
Overall Mean	4.42	0.5653	Highly Acceptable
Aroma	Mean	Sd	Description
The aroma is subtle	4.35	0.6622	Highly Acceptable
The finished product smells good	4.35	0.5796	Highly Acceptable
The aroma is detectable	4.48	0.7157	Highly Acceptable
The ingredients' aroma is tolerable	4.55	0.7143	Highly Acceptable
The overall aroma is desirable	4.43	0.7121	Highly Acceptable
Overall Mean	4.43	0.5576	Highly Acceptable
Taste	Mean	Sd	Description
The taste of the product is acceptable	4.63	0.5856	Highly Acceptable
The taste is detectable	4.50	0.5547	Highly Acceptable
The taste of the other ingredients is present	4.58	0.5494	Highly Acceptable
The product is with aromatic taste	4.63	0.6279	Highly Acceptable
The taste of the product is exquisite	4.60	0.5905	Highly Acceptable
Overall Mean	4.59	0.4035	Highly Acceptable

Sensorial Evaluation of Bamboo Shoot (*Bambusa Merrilliana*) Flour as Pasta

<i>Texture</i>	Mean	Sd	Description
The product has a good texture	4.33	0.6938	Highly Acceptable
The product is al dente (firm and slightly chewy)	4.35	0.6998	Highly Acceptable
The texture is consistent from the surface to the inner part	4.43	0.7121	Highly Acceptable
The product is comparable to commercial pasta	4.43	0.6751	Highly Acceptable
The overall texture is highly acceptable	4.55	0.6775	Highly Acceptable
Overall Mean	4.42	0.5981	Highly Acceptable

The provided data exhibits the evaluation of bamboo shoot flour used as pasta in Lasagna across various criteria, appearance/color, aroma, taste, and texture. As presented in the table, respondents found the appearance/color of the bamboo shoot flour pasta highly acceptable. All individual criteria (a to e) scored highly, with means ranging from 4.38 to 4.50. The scores indicate that the pasta was perceived to have attractive color, freshness, and comparability to traditional pasta, making it visually appealing for use in lasagna. Likewise, scores for aroma-related criteria ranged from 4.35 to 4.55. The overall mean is 4.43 with a standard deviation of 0.5576. This means that the aroma of the bamboo shoot flour pasta was also highly rated. It was described as subtle, good-smelling, detectable, and desirable overall. These scores suggest that the aroma contributes positively to the sensory experience of the pasta dish. Similarly, the scores for taste-related criteria ranged from 4.50 to 4.63, with an overall mean for taste of 4.59 and a standard deviation of 0.4035. This indicates that the taste of the bamboo shoot flour pasta received high praise. It was deemed acceptable, detectable, aromatic, and exquisite, with all criteria scoring above 4.5 on average. This indicates that the taste profile of the pasta was well-received and enjoyable. Moreover, the overall mean for texture is 4.42 described as highly acceptable. Scores for texture-related criteria ranged from 4.33 to 4.55. Texture was consistently rated highly across all aspects. The pasta was noted for its good texture, consistency, uniformity from surface to inner part, and comparability to commercial pasta. This suggests that the texture of the bamboo shoot flour pasta meets the standards expected for lasagna. In conclusion, based on the data provided, the bamboo shoot flour pasta demonstrates high acceptability across all evaluated criteria for its use in lasagna. The positive ratings for appearance, aroma, taste, and texture indicate that it can be considered a viable and well-liked option for those looking for alternatives to conventional wheat-based pasta. The study of Zhang et al (2017) entails the ability of bamboo shoots to distribute and stand the moisture content that can be used to support the feasibility of the flour to produced pasta. This is seen to the results that the production of lasagna using the bamboo shoots is highly accepted and feasible, the study correlated to the results making it more comprehensive.

Table 11. General Level of Acceptability of the Bamboo Shoot Pasta in Spaghetti, Carbonara, and Lasagna in Terms of Appearance/Color, Aroma, Taste, and Texture as Perceived by the Children

<i>Dish</i>		Mean	Sd	Description
<i>Spaghetti</i>	Appearance/Color	4.68	0.3293	Highly Acceptable
	Aroma	4.50	0.5011	Highly Acceptable
	Taste	4.58	0.3706	Highly Acceptable
	Texture	4.36	0.4695	Highly Acceptable
Overall Mean		4.53	0.2850	Highly Acceptable
<i>Carbonara</i>	Appearance/Color	4.46	0.4624	Highly Acceptable
	Aroma	4.18	0.4662	Moderately Acceptable
	Taste	4.48	0.4341	Highly Acceptable
	Texture	4.56	0.4402	Highly Acceptable
Overall Mean		4.42	0.3409	Highly Acceptable
<i>Lasagna</i>	Appearance/Color	4.50	0.4447	Highly Acceptable
	Aroma	4.58	0.3824	Highly Acceptable
	Taste	4.66	0.4326	Highly Acceptable
	Texture	4.62	0.4940	Highly Acceptable
Overall Mean		4.59	0.3315	Highly Acceptable

The table exhibits a comprehensive analysis of the general level of acceptability of Bamboo Shoot Pasta across different dishes Spaghetti, Carbonara, and Lasagna as perceived by different groups of respondents specifically children. The criteria were the appearance/color, aroma, taste, and texture. For the dish Spaghetti, the children found bamboo shoot pasta in spaghetti highly acceptable in all criteria having the appearance/color as the highest with a mean of 4.68 while its texture was rated as the lowest with

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a mean of 4.56. Findings suggest that the dish was noted for its very attractive appearance/color, good aroma, enjoyable taste, and satisfactory texture. The overall mean score of 4.53 suggest that the dish is highly acceptable among children suggesting strong approval across all sensory aspects for this dish among children. Children rated bamboo shoot pasta in carbonara slightly lower than in spaghetti but still highly acceptable. It received good score for texture with mean score of 4.56, while aroma was rated with the lowest mean score of 4.18 and regarded as moderately acceptable. An overall mean score of 4.42 and a standard deviation of 0.3409 indicate a strong overall acceptance among children for the dish. Children rated bamboo shoot pasta in lasagna similarly to spaghetti in terms of overall acceptability. It received high scores across all criteria, with particularly high mean score for taste with a mean score of 4.66 perceived as highly acceptable by the children. The overall mean of 4.59 indicates that children highly appreciate and highly accept bamboo shoot pasta in lasagna. In conclusion, the data suggests that Bamboo Shoot Pasta is well-liked and highly acceptable among children across various dishes including Spaghetti, Carbonara, and Lasagna. Its sensory attributes, including appearance, aroma, taste, and texture, meet or exceed expectations for traditional pasta dishes. This positive reception indicates its potential as a nutritious and appealing alternative for children's meals, catering to both sensory satisfaction and nutritional benefits. On the study of Maroma (2015) states that the bamboo shoots utilized in chips production as an alternative snacks is like by the respondents, this is consonance to the result of the pasta in children wherein it is highly acceptable making it in consideration that the pasta can be an alternative snacks for children based on the level of acceptability indicated in the data.

Table 12. General Level of Acceptability of the Bamboo Shoot Pasta in Spaghetti, Carbonara, and Lasagna in Terms of Appearance/Color, Aroma, Taste, and Texture as Perceived by the Teenagers

<i>Dish</i>		Mean	Sd	Description
<i>Spaghetti</i>	Appearance/Color	4.72	0.3553	Highly Acceptable
	Aroma	4.50	0.4243	Highly Acceptable
	Taste	4.76	0.2066	Highly Acceptable
	Texture	4.76	0.3098	Highly Acceptable
Overall Mean		4.69	0.2346	Highly Acceptable
<i>Carbonara</i>	Appearance/Color	4.86	0.1897	Highly Acceptable
	Aroma	4.70	0.2357	Highly Acceptable
	Taste	4.74	0.3134	Highly Acceptable
	Texture	4.70	0.3801	Highly Acceptable
Overall Mean		4.75	0.2211	Highly Acceptable
<i>Lasagna</i>	Appearance/Color	4.64	0.3671	Highly Acceptable
	Aroma	4.54	0.3658	Highly Acceptable
	Taste	4.68	0.3011	Highly Acceptable
	Texture	4.54	0.4006	Highly Acceptable
Overall Mean		4.60	0.3197	Highly Acceptable

The table displays a comprehensive analysis of the general level of acceptability of Bamboo Shoot Pasta across different dishes-Spaghetti, Carbonara, and Lasagna- as perceived by the Teenagers. The criteria were the appearance/color, aroma, taste, and texture. Teenagers rated Bamboo Shoot Pasta in Spaghetti very highly across all criteria. It received outstanding scores for appearance/color, taste, and texture, all averaging above 4.6. Aroma, although slightly lower having a mean score of 4.50, was still considered highly acceptable. The overall mean score of 4.69 indicates strong approval across all sensory aspects for this dish among teenagers. Similarly, the Bamboo Shoot Pasta in Carbonara received even higher ratings from teenagers. It excelled particularly in appearance/color, with a mean score of 4.86, indicating very attractive presentation. Aroma, taste, and texture also scored highly, with all criteria averaging above 4.7. The overall mean of 4.75 reflects very strong acceptance among teenagers for this dish. However, the Teenagers rated Bamboo Shoot Pasta in Lasagna slightly lower than in Spaghetti and Carbonara, but still highly acceptable. It received good scores across all criteria, with taste and appearance/color being notable strengths with mean scores of 4.68 and 4.64, respectively. Texture and aroma were also well-regarded, although texture received slightly lower scores compared to the other dishes. The overall mean of 4.60 indicates solid acceptance for Bamboo Shoot Pasta in Lasagna among teenagers. The data indicates that Bamboo Shoot Pasta is highly accepted by teenagers across different traditional Italian dishes including Spaghetti, Carbonara, and Lasagna. Its sensory attributes, including appearance, aroma, taste, and texture, meet or exceed expectations for traditional pasta dishes. This positive reception underscores its potential as a favorable alternative for teenagers, appealing not only for its sensory qualities but also potentially for its nutritional benefits. The study of Gabuyo finds that the level of acceptability of

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moringa and squash in the production of pasta among teenagers in different sensorial evaluation is highly acceptable. This shows support on the data that is presented that the bamboo shoot pasta evaluated by the teenagers is highly acceptable.

Table 13. General Level of Acceptability of the Bamboo Shoot Pasta in Spaghetti, Carbonara, and Lasagna in Terms of Appearance/Color, Aroma, Taste, and Texture as Perceived by the Adults

<i>Dish</i>		Mean	Sd	Description
<i>Spaghetti</i>	Appearance/Color	4.44	0.4300	Highly Acceptable
	Aroma	4.84	0.2271	Highly Acceptable
	Taste	4.58	0.3458	Highly Acceptable
	Texture	4.68	0.3676	Highly Acceptable
Overall Mean		4.64	0.2186	Highly Acceptable
<i>Carbonara</i>	Appearance/Color	4.44	0.4789	Highly Acceptable
	Aroma	4.72	0.2530	Highly Acceptable
	Taste	4.66	0.3658	Highly Acceptable
	Texture	4.66	0.3777	Highly Acceptable
Overall Mean		4.62	0.3111	Highly Acceptable
<i>Lasagna</i>	Appearance/Color	4.76	0.2066	Highly Acceptable
	Aroma	4.70	0.2539	Highly Acceptable
	Taste	4.72	0.2700	Highly Acceptable
	Texture	4.74	0.3134	Highly Acceptable
Overall Mean		4.73	0.2030	Highly Acceptable

The data provided evaluate the general level of acceptability of Bamboo Shoot Pasta in Spaghetti, Carbonara, and Lasagna as perceived by adults in terms of Appearance/Color, Aroma, Taste, Texture. Adults rated Bamboo Shoot Pasta in Spaghetti highly across all criteria. It received strong score for aroma having a mean score of 4.84, while appearance/color was rated with a mean score of 4.44, it was still rated highly acceptable. The overall mean score of 4.64 indicates strong approval across all sensory aspects for this dish among adults since the adults agreed that the dish is highly acceptable. Bamboo Shoot Pasta in Carbonara also received high ratings from adults. It scored well across all criteria, with aroma being particularly strong points with a mean score of 4.72. Similar to spaghetti, the aroma for carbonara was given mean score of 4.44 but still described as highly acceptable. The overall mean of 4.62 reflects strong acceptance among adults for this dish. Adults rated Bamboo Shoot Pasta in Lasagna highest among the three dishes. It received excellent scores across all criteria, with particularly high marks for appearance/color with a mean score of 4.76. Aroma and taste were also highly rated, contributing to the overall mean of 4.73, which indicates very strong acceptance for Bamboo Shoot Pasta in Lasagna among adults. In conclusion, the data suggests that Bamboo Shoot Pasta is highly accepted by adults across different traditional Italian dishes including Spaghetti, Carbonara, and Lasagna. its sensory attributes, including appearance, aroma, taste, and texture, meet or exceed expectations for traditional pasta dishes. This positive reception underscores its potential as a nutritious and appealing alternative for adult consumers, appealing both for its sensory qualities and potentially for its nutritional benefits. The result of the study is supported by the study of Dela Cruz (2024) wherein the banana pseudo stem pasta is perceived by the adults as highly accepted on the different sensorial evaluation. Composite flour integration like the banana pseudo stem and bamboo shoots in making pasta is highly accepted by the group of respondents of adults in different sensorial evaluation.

Table 14 General Level of Acceptability of the Bamboo Shoot Pasta in Spaghetti, Carbonara, and Lasagna in Terms of Appearance/Color, Aroma, Taste, and Texture as Perceived by the Food Experts

<i>Dish</i>		Mean	Sd	Description
<i>Spaghetti</i>	Appearance/Color	3.46	0.9891	Moderately Acceptable
	Aroma	3.44	0.5873	Moderately Acceptable
	Taste	3.66	0.7183	Moderately Acceptable
	Texture	2.92	0.5827	Acceptable
Overall Mean		3.37	0.6321	Acceptable
<i>Carbonara</i>	Appearance/Color	3.78	0.7569	Moderately Acceptable
	Aroma	4.28	0.4662	Highly Acceptable
	Taste	4.26	0.5892	Highly Acceptable
	Texture	3.76	0.5232	Moderately Acceptable

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Overall Mean		4.00	0.4246	Moderately Acceptable
Lasagna	Appearance/Color	3.78	0.6070	Moderately Acceptable
	Aroma	3.90	0.7557	Moderately Acceptable
	Taste	4.28	0.4638	Highly Acceptable
	Texture	3.76	0.6240	Moderately Acceptable
Overall Mean		3.93	0.5213	Moderately Acceptable

The data provided evaluates the general level of acceptability of Bamboo Shoot Pasta in Spaghetti, Carbonara, and Lasagna as perceived by Food Experts in terms of Appearance/Color, Aroma, Taste, Texture. Food experts rated Bamboo Shoot Pasta in Spaghetti as moderately acceptable. It received lower scores compared to other groups, particularly in texture, which was rated just "Acceptable" with a mean score of 2.92. Taste was considered moderately acceptable with a mean score of 3.66, indicating room for improvement. The overall mean of 3.37 suggests that there is some reservation among food experts regarding the sensory attributes of Bamboo Shoot Pasta in Spaghetti. Bamboo Shoot Pasta in Carbonara received moderately acceptable ratings from food experts. Aroma and taste were rated highly acceptable with mean scores of 4.28 and 4.26, respectively, indicating strong positive perception in these areas. However, texture received lowest mean score of 3.76, suggesting that improvements could enhance its acceptability. The overall mean of 4.00 places it at a moderately acceptable level among food experts. Food experts rated Bamboo Shoot Pasta in Lasagna similarly to Carbonara, as moderately acceptable. Taste was rated highly acceptable with a mean score of 4.28, indicating a strong positive perception, while appearance/color, aroma, and texture were considered moderately acceptable with texture having the lowest mean score of 3.76. The overall mean of 3.93 suggests that while there are strengths in taste, improvements in other sensory aspects could enhance overall acceptability. The data indicates that food experts perceive Bamboo Shoot Pasta as having potential but also identify areas where improvements are needed, particularly in appearance/color and texture. While taste and aroma generally received positive feedback, the lower ratings in texture and appearance suggest that adjustments may be necessary to meet the expectations of food experts. This feedback can guide further development to enhance the overall acceptability of Bamboo Shoot Pasta in culinary applications. The study of Ibrahim et al (2024) affirms the sensorial evaluation of the food experts as they find out that the bamboo shoots in the variety of *Bambusa vulgaris* in pasta production is seen to impact the quality of the pasta as the different treatment conducted on the study the adopted 75% and 25% ratio is seen to have acceptable verdict among respondents connected to the study, data shows that the level of acceptability of food experts in different pasta is in between highly acceptable to acceptable, the stated related study justify the findings of the present result.

Table 15. Comparison in the Level of General Acceptability of the Bamboo Shoot Pasta in Spaghetti, Carbonara, and Lasagna in Terms of Appearance/Color, Aroma, Taste, and Texture as Evaluated by the Different Groups of Respondents

Pasta Dish	Criteria	F-Value	χ^2 -Value	Decision	Remarks
Spaghetti	Apperance/Color	9.9539	0.0001	Reject H_0	Significant
	Aroma	17.8776	0.0000	Reject H_0	Significant
	Taste	12.1292	0.0000	Reject H_0	Significant
	Texture	37.1865	0.0000	Reject H_0	Significant
Carbonara	Apperance/Color	7.6084	0.0005	Reject H_0	Significant
	Aroma	6.7626	0.0010	Reject H_0	Significant
	Taste	2.3677	0.0870	Accept H_0	Not Significant
	Texture	10.4452	0.0000	Reject H_0	Significant
Lasagna	Apperance/Color	10.4442	0.0000	Reject H_0	Significant
	Aroma	5.6563	0.0028	Reject H_0	Significant
	Taste	2.9670	0.0448	Reject H_0	Significant
	Texture	8.8535	0.0002	Reject H_0	Significant

The provided data presents the comparison in the level of general acceptability of Bamboo Shoot Pasta in Spaghetti, Carbonara, and Lasagna as evaluated by respondents. The sensory attributes evaluated are appearance/color, aroma, taste, and texture. For Spaghetti, all criteria (Appearance/Color, Aroma, Taste, and Texture) show significant differences in acceptability among the respondents. This is evident by the computed χ^2 -values which are all less than 0.05 acceptability level. Thus, there is a failure to accept the null hypothesis. This means that there are clear distinctions in how respondents perceive Bamboo Shoot Pasta in Spaghetti across these sensory attributes. In Carbonara, Appearance/Color, Aroma, and Texture show significant differences in acceptability among respondents. However, Taste did not show a significant difference as shown by the computed χ^2 -value of 0.0870, indicating that

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respondents did not perceive significant variation in taste across different evaluations of Bamboo Shoot Pasta in Carbonara. For Lasagna, all criteria (Appearance/Color, Aroma, Taste, and Texture) show significant differences in acceptability among respondents. All the computed χ^2 -values have higher value than 0.05, hence, the null hypothesis is not accepted. This indicates that there are noticeable variations in how respondents perceive Bamboo Shoot Pasta in Lasagna across these sensory attributes. The analysis highlights that respondents perceive Bamboo Shoot Pasta differently across Spaghetti, Carbonara, and Lasagna primarily in terms of Appearance/Color, Texture, and Aroma. These attributes significantly influence the overall acceptability of the pasta dishes. Taste, while important, did not consistently show significant variation across all dishes.

Shelf-life of Bamboo Shoot Pasta

The develop product of this study which is the bamboo shoot pasta is best after it is made. However, to determine the shelf life of the developed product, storing it in a closed container and in an open space (bilao) at a room temperature caused a different result. The products are observed for about two weeks.

Table 16. Shelf-life of Bamboo Shoot Pasta

Observation and Remarks		
	Container	Bilao
Day 1	The bamboo shoot pasta had a perfect appearance and aroma.	The bamboo shoot pasta had a perfect appearance and aroma.
Day 2	The smell of pasta was still bamboo, the texture became softened, and the appearance retained its perfect shape.	Some parts of the pasta became hard in texture, but the smell remained bamboo shoot, and the appearance still had a perfect form.
Day 3	The texture of pasta was still soft, the smell remained bamboo, the appearance retained its perfect shape, the color became a golden brown, and it started to show moisture.	The texture of pasta became very dry, the smell was still bamboo shoot, the appearance retained its perfect shape, and the color turned to desert gray shades of brown.
Day 4	The white mold appeared in the pasta, the smell became moldy but still had a bamboo scent, and it continued to show moisture.	The pasta was dry, had no mold, and still smelled like bamboo shoot.
Day 5	The amount of mold increased and included black mold, the smell became unpleasant, and there was significant moisture.	The pasta remained dry, with no changes in texture, smell, or appearance.
Day 6	Black and green mold appeared. The pasta was very moist and smelled bad, although there was still a faint bamboo scent. The appearance was poor due to the mold.	No changes. The pasta was dry, with a bamboo smell and consistent appearance.
Day 7	Mold growth worsened significantly, the smell became increasingly unpleasant, and the appearance degraded with visible patches of mold.	The pasta remained dry, the bamboo shoot smell persisted, and the appearance retained its perfect shape with no visible mold.
Day 8	Mold coverage continued to increase, the smell became more worse, and the visual quality of the pasta was heavily impacted.	The texture stayed dry, the smell remained unchanged, and the pasta continued to be mold-free.
Day 9	Mold continued to thrive with no significant changes, the smell remained moldy, and the pasta looked unappealing.	The pasta maintained its dry texture, the smell stayed bamboo-like, and there were no visible changes in appearance.
Day 10	Mold growth increased, the smell became unbearable, and the pasta looked completely spoiled.	The dry texture persisted, the bamboo scent remained, and the appearance stayed mold-free.
Day 11	Mold reached its peak coverage, the smell was extremely strong and unpleasant, and the pasta appeared entirely spoiled.	The pasta's texture stayed dry, the smell remained bamboo, and the appearance did not change.
Day 12	The mold was extensive with no significant increase, the strong, unpleasant odor continued, and the appearance was fully compromised.	The texture continued to be dry, the bamboo aroma persisted, and the appearance stayed the same.
Day 13	No additional changes in mold growth, the smell remained consistently bad, and the pasta stayed heavily molded.	The pasta's texture remained dry, the smell stayed bamboo, and there were no changes in appearance.
Day 14	The pasta remained heavily molded, the unpleasant smell persisted, and the appearance was still severely impacted.	The pasta maintained its dry texture, the smell stayed the same, and the appearance remained mold-free.

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This observation suggests that while container storage might preserve the initial softness of the pasta, it also creates an environment conducive to mold growth, the bamboo shoot pasta in a closed container can last long for 3 days as it is observed in the 4th day that molds become evident to the pasta. Conversely, storing the pasta in a *bilao* may lead to drying out but prevents mold and keeps the pasta in a more stable condition over a longer period. The pasta in an open space (*bilao*) is seen to be in good condition without fully drying for at least 2 days but can last for two weeks in terms of its shelf life as the bamboo shoot pasta dries, making it last long as water content is one factor why molds and spoilage occurs. The shelf life of fresh pasta is affected by its high-water content, fresh pasta is easily perishable (Del Nobile, et al 2009). Several studies conducted to prolong shelf life in terms of production, packaging and to the type of the storage (Tashim et al, 2021). Study conducted by Lordi et al (2023) wherein olive oil and pomegranate peel is used to extend the shelf life of the pasta, result reveals that the materials is useful to prolong the shelf life of a pasta. Other studies include preservative and different environment situation like vacuum packaging, refrigeration and changed atmosphere were evaluated (Del Torre et al, 2004, Sanguinetti, et al 2016).

RECOMMENDATIONS

In the light of the foregoing findings and conclusion, the researcher recommends the following:

1. Technical teachers, students and homemakers are encouraged to do more research and innovation in making of quality food products using available local ingredients/materials.
2. Further research is still necessary to explore different types of flour to be added for the enhancement of the shape of pasta strands and texture, also to explore the different variety of bamboo shoots
3. Pasta made from bamboo shoot flour should be cooked aligned to the preferred recipes and to be prepared on the day to be served for optimal quality.
4. Bamboo shoot flour be adapted in making pasta for home of family consumption. And to explore different recipes of pasta using bamboo shoot flour is needed to explore its compatibility to other pasta recipes.
5. Similar studies must be made for its marketability, profitability and nutritional value.
6. Further research is needed to improve the products storage to lessen the moisture content and to further explore the state of dry pasta in the bamboo shoot pasta consonance to the commercial brought pastas.
7. The bamboo shoot flour pasta is recommended to store in an open space (*bilao*) to avoid the growth of molds in a long period of time.
8. Researchers may consider to explore making other food products using the same raw ingredients.
9. School administration may consider the possible income generating projects in consonance to the findings of the study with the collaboration of the Research and Extension Office, Resource Generation and Management Office and Technical Teachers.
10. Local Government Unit may consider the bamboo shoot flour as pasta in one town, one product campaign of the government, as bamboo shoot is highly available in the province.
11. Dietician may include the bamboo shoot pasta as an alternative variety in the planning of food choices among plant based dietary.
12. Parents are highly recommended to introduce the bamboo shoots pasta as an alternative pasta snack for children or celebration feast.
13. Community pasta makers can integrate the product of this study for economic and market gain of the bamboo shoot pasta
14. The study can be applied for utility model at the Intellectual Property Office of the Philippines (IPOPHL).

CONCLUSIONS

Based on the findings of the study, the bamboo shoots flour as pasta used in spaghetti, carbonara, and lasagna was found to be highly acceptable to the respondents. The sensorial evaluation revealed that the bamboo shoot flour pasta in spaghetti was highly acceptable in terms of appearance/color, aroma, and taste, while texture was moderately acceptable. In contrast, carbonara and lasagna showed consistent high acceptability across all four sensory attributes. The comparison of the level of acceptability revealed significant differences in acceptability among the sensory attributes of Appearance/Color, Aroma, Taste, and Texture across the three pasta dishes. Furthermore, the storage conditions of the bamboo shoot flour pasta showed that it lasted for 2-3 days when stored at normal temperature in closed containers before mold appeared on the 4th day. However, when stored in an open space (*bilao*), it retained its original texture and moisture for 2 days before becoming dry but did not show signs of mold or change in smell or form up to 14 days. Overall, the study suggests that bamboo shoots flour as pasta is a highly acceptable ingredient in various pasta dishes with variations in acceptability across different groups of respondents and storage conditions. This is also constituting that bamboo shoot pasta is palatable for human consumption wherein further research is still necessary to improve the existing product. Thus, this study offers feasible approach for the utilization of bamboo shoot in different types of pasta and recipes.

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