

**ACCEPTABILITY OF BLACK RICE *Oryza sativa* L. Indica  
PUTO PAO; A PROPOSED TECHNOLOGY GUIDE**

**College of Teacher Education  
BOBOL ISLAND STATE UNIVERSITY  
Zamora, Bilar, Bohol**

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**June 2002**

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June 2022

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A PROPOSED TECHNOLOGY GUIDE

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A Thesis  
Presented to the Faculty of the  
College of Teacher Education  
BOHOL ISLAND STATE UNIVERSITY  
Zamora, Bilar, Bohol

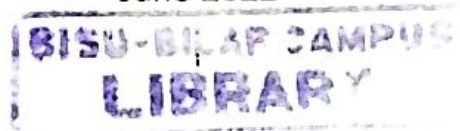
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In Partial Fulfillment  
of the Requirements for the Degree  
in Bachelor of Technology and Livelihood Education  
Major in Home Economics

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FRITZ LOUIE S. NAYVE  
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June 2022



## APPROVAL SHEET

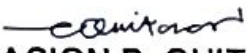
This thesis entitled "ACCEPTABILITY OF BLACK RICE *Oryza sativa L. indica* PUTO PAO; A PROPOSED TECHNOLOGY GUIDE", prepared and submitted by Fritz Louie S. Nayve, Sean Steven H. Tinaja and Edcel N. Coronel in partial fulfillment of the requirements for the degree of Bachelor in Technology and Livelihood Education major in Home Economics has been examined and recommended for acceptance and approval for oral defense.

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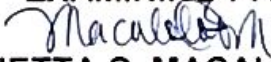
  
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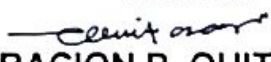
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Edcel N. Coronel  
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## ABSTRACT

The goal of this experiment was to establish the acceptability of black rice puto cheese in terms of appearance, aroma, taste, texture, and overall acceptability. The study also determined if there's a significant difference in the acceptability level of the three (3) treatments. To evaluate black rice puto pao, the researchers employed a quasi-experimental procedure using an altered and modified observation guide. There were 40 selected food technology teachers and food-majoring students from the Sierra-Bullones Technical Vocational High School who were served as respondents. The quasi-experimental design exposed all respondents to the (3) three treatments generated using the descriptive analysis method. The respondents' sensory preferences and general acceptability of the three treatments were determined using a 4-point hedonic scale sensory evaluation tool. The data was tallied using the weighted mean to estimate the sensory degree of acceptability based on the respondents' perceptions. The significant difference in the level of acceptance of the three Black Rice Puto Pao treatments was determined using One-Way Anova. Treatment 3 was deemed the most acceptable by evaluators among the three treatments. Analysis of the data showed that there is no significant difference between the three treatments. The Technology and Livelihood Education instructors handling food-related subjects may utilize the technology guide in the student's activity and practicum. The Technology Livelihood students and the Food Technology and Entrepreneurship students could utilize black rice puto cheese in making income-generating products. The product will be utilized and introduced for community consumption to promote the product. The school administration may encourage students to promote products from underutilized resources. Future researchers may conduct related studies to develop more products utilizing black rice.

## TABLE OF CONTENTS

TITLE PAGE	.....	i
APPROVAL SHEET	.....	ii
ACKNOWLEDGMENT	.....	iii
ABSTRACT	.....	iv
TABLE OF CONTENT	.....	vi
LIST OF TABLES	.....	vii
LIST OF FIGURES	.....	vii
CHAPTER		

### 1. THE PROBLEM AND ITS SCOPE

Rationale	.....	1
Literature Background	.....	2
Conceptual Framework	.....	8

### THE PROBLEM

Statement of the Problem	.....	10
Significance of the Study	.....	11

### RESEARCH METHODOLOGY

Experimental Design	.....	11
Environment and Participants	.....	12
Research Procedure	.....	13
Statistical Treatment	.....	14

DEFINITION OF TERMS	.....	15
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## **2. PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA**

The Profile of the Black Rice Puto Pao .....	17
Acceptability of Black Rice Puto Pao in Terms of Appearance, Aroma, Taste, Texture .....	22
The Significant Difference of Acceptability of Black Rice Puto Pao in Different Treatments .....	25

## **3. SUMMARY OF FINDINGS, CONCLUSIONS & RECOMENDATIONS**

Summary .....	27
Findings .....	28
Conclusions .....	29
Recommendations .....	29

<b>REFERENCES</b> .....	40
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### **APPENDICES**

Appendix A Questionnaire .....	44
Appendix B Transmittal Letter .....	45
Appendix C Black Rice and Black Rice Flour.....	49
Appendix D Technology Guide .....	50
Appendix E Raw Data .....	51

<b>RESEARCHERS' BIODATA</b> .....	52
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## LIST OF TABLES

<b>Tables</b>		<b>Page</b>
1	Ingredients and Cost of Black Rice Puto Pao .....	18
2	Tools and Equipment Used .....	21
3	Acceptability Level of Black Rice Puto Pao .....	22
4	Difference among the Treatments of Black Rice Puto Pao.....	26

## LIST OF FIGURES

<b>Figures</b>		<b>Page</b>
1	Theoretical and Conceptual Framework .....	9
2	Experimental Layout of the Study .....	11
3	Location Map of the Environment and Participants .....	12

## Chapter 1

### THE PROBLEM AND ITS SCOPE

#### Rationale

Puto is derived from the Malay word "puttu," which means portioned. These bite-sized cakes stuffed with sweet pork or meat filling are a tribute to the Chinese meat bun. Puto pao is now becoming a popular snack among Filipinos and does great business. It only needs small capital to start and is easy to make. If one is an excellent businessman minded, this might turn one into a millionaire or cook this for the family.

Black rice, also called purple rice, forbidden rice, and Chinese black rice, is a type of whole-grain rice that is quite dark in color. It can be completely black, darker purple, or burgundy with multicolored kernels. When black rice is cooked, it turns dark purple. Black rice gets its dark color from the antioxidant called anthocyanin. Black rice tastes very similar to brown rice and is often described as having a "nutty" flavor. It is pretty dense and chewy. Depending on the cooking method, black rice can also be quite sticky. Black rice is very nutritious. It is high in antioxidants, protein, and fiber and is a good source of iron. (MasterClass, 2021)

Nonetheless, black rice contains the highest amount of antioxidants, protein, and dietary fiber of all rice varieties. One serving of black rice (1/4 cup or 50g) contains approximately 160 calories. Each serving of this type of rice contains 5g of protein and 2g of fiber, and 1g of iron. Both brown rice and black rice contain vitamins, minerals, and dietary fiber. However, black rice is superior to brown rice because it contains more protein and fiber than brown rice.

Moreover, black rice has an extremely high antioxidant content, which provides several additional health benefits (Thanuja & Parimalavalli, 2018).

In this connection, the researchers are motivated to innovate a new type of puto pao utilizing black rice as a featured ingredient of the product development. Thus, the study on the acceptability of black rice *Oryza sativa L. indica* puto pao.

### **Literature Background**

Puto Pao is one of the many different types of Puto, usually white. From the usual Puto, variants of Puto recipes started to emerge like, Puto Bungbong, Puto Maya, Puto Manapla, Puto Lanson, Puto Flan, and this recipe, Puto Pao. This Puto Pao is similar to plain Puto and has a filling like a siopao. This is made of rice or all-purpose flour with pork fillings and topped with salted eggs, usually served during merienda or snacks. Certain towns of the Philippines like Biñan City, Laguna, Valenzuela City, Calasiao, Pangasinan, and Manapla, Negros Occidental have excelled in the production and marketing of particular style of puto that their names are used to identify the variety (Panlasang Pinoy Recipes, 2012).

The state shall protect and promote the people's right to health and health consciousness among them, according to Article II, Section 15 of the 1987 Philippine Constitution. This involves adopting an integrated and holistic approach to health creation that aims to make essential goods, health, and other social services accessible to all at a reasonable cost.

In addition, food, as defined by Republic Act No. 10611, also known as the "Food Safety Act of 2013," is any material or commodity intended for human consumption and is refined, partially processed, or unprocessed. It includes drinks, chewing gums, water, and other substances that are added to food during the manufacturing, preparation, or treatment process (Aquino et al., 2013)

According to Article XIV, Section 10 of the Philippine Constitution, the state must prioritize research and development, innovation, and other uses. In this regard, the state must support the establishment, organization, and expansion of activities in order for goods and services to be produced in order to alleviate the economic crisis and contribute to the country's growth. Furthermore, the government will welcome any proposals that will contribute and be open to existing issues that are racing with the aid of new products. Furthermore, the state must defend and promote the people's right to a balanced and healthy ecology that syncs with nature's rhythms.

In addition, Section 10, Article XIV of the 1987 Philippine Constitution states that: Science and Technology are essential for national development and progress. The state shall prioritize research and development, invention, innovation, and utilization, and science and technology education, training, and services. Science and Technology hold the key to the solution of the old-age and seemingly intractable problem of disease, poverty, and unemployment among a significant number of our people and the achievement of our goal of economic self-reliance and independence, particularly in the two areas: food production and energy source exploration and development.

"Philippine Design Competitiveness Act of 2013", or Republic Act No. 10557, is an Act promoting and strengthening Filipino Design, providing for a national design policy and renaming the product development and design center of the Philippines into the design center of the Philippines and for other purposes. The state shall enhance the competitiveness and innovation of Philippine products and create market-responsive design services while advocating for economic and environmental sustainability. In addition, the state shall also endeavor to promote an economy and society driven by design and creativity responsive to our fast-changing times and reflective of the Filipino culture and identity. While concurrently advocating the protection of intellectual property rights to these ideas and innovations (Aquino et al., 2013).

To effectively carry out this mandate, the design center shall undertake research and development on the design and assets of the Philippines (i.e., manipulation and development of raw materials that are indigenous to the country) so we can be able to come up with the globally relevant yet uniquely Filipino innovations.

Crops Act of 2013 seeks to accelerate the growth and development of agriculture, enhance productivity and incomes of farmers and the rural population, improve the investment climate and efficiency of agribusiness and develop crops as export crops. To promote crop production, processing, marketing, and distribution in suitable areas.

According to Brennan (2020), black rice is rich in amino acids, fatty acids, antioxidants, flavonoids, anthocyanins, and other phenolic compounds. There are

18 amino acids in black rice, with a mix of essential and non-essential types. Amino acids are crucial to many body functions, from helping repair skin and tissues to improving energy levels and digestion. Black rice is that rare, delicious, healthy, and aesthetically pleasing trifecta. This dark-colored rice, a deep purple-black, has alternate names, including purple rice, forbidden rice, and emperor's rice. It has a rich, complex flavor, distinct nuttiness, and a hint of sweetness from the anthocyanin pigments.

According to Hendrick (2010), black rice is rich in anthocyanin antioxidants, substances that show promise for fighting cancer, heart disease, and other health problems, Xu says. He adds that food manufacturers could use black rice bran or bran extracts to boost the health value of breakfast cereals, beverages, cakes, cookies, and other foods. He says black rice bran would be a unique and inexpensive way to increase people's antioxidant intake, promoting health.

According to the study by Young et al. (2019) entitled, "Black Rice (*Oryza sativa* L.) Fermented with *Lactobacillus casei* Attenuates Osteoclastogenesis and Ovariectomy-Induced Osteoporosis," the bran fraction of black rice (*Oryza sativa* L.) is a rich source of antioxidant compounds, including anthocyanins and tocopherol. Anthocyanins, such as cyanidin-3-O-glucoside and peonidin-3-O-glucoside, are the foremost effective constituents of black rice, and they help protect arteries, prevent oxidative DNA damage and inhibit the formation of cell-damaging free radicals. According to a recent report, black rice extract exerts osteogenic activities by stimulating osteoblast differentiation. It has also been

shown that daily oral administration of black rice extract at 200 mg/kg for eight weeks prevents bone density and strength decreases in ovariectomized rats. Previously it was reported that black rice bran fermented with fungi and lactic acid bacteria could be utilized as a health-functional food and pharmaceutical agent. Additionally, several prebiotics cause changes in intestinal microorganisms. These changes are closely related to increased bone mineral density and strength and increased calcium absorption in animal models of inflammation.

According to the study by Thanuja and Parimalavalli (2018) entitled "Role of Black Rice in Health and Diseases," black rice is a type of rice species *Oryza sativa L.* It is consumed as a functional food due to its usefulness to health. Black rice contains higher levels of proteins, vitamins, and minerals than white rice. Black rice contains essential amino acids like lysine and tryptophan; vitamins such as vitamin B1, vitamin B2, and folic acid; it is a good source of minerals, including iron, zinc, calcium, phosphorus, and selenium. It contains the highest amount of antioxidants, protein, and dietary fiber of all rice varieties. Besides, it has phenolics, flavonoids, and anthocyanins. Antioxidants are the first line of defense against free radical damage and are critical for maintaining optimum health and well-being. These antioxidant compounds have tremendous health benefits and can reduce the risk of developing various chronic diseases. This rice enhances health and longevity, protects heart health, reduces atherosclerosis, controls hypertension, improves the digestive system, has anti-inflammatory action, reduces allergy, detoxifies the body, improves lipid profile, reduces the

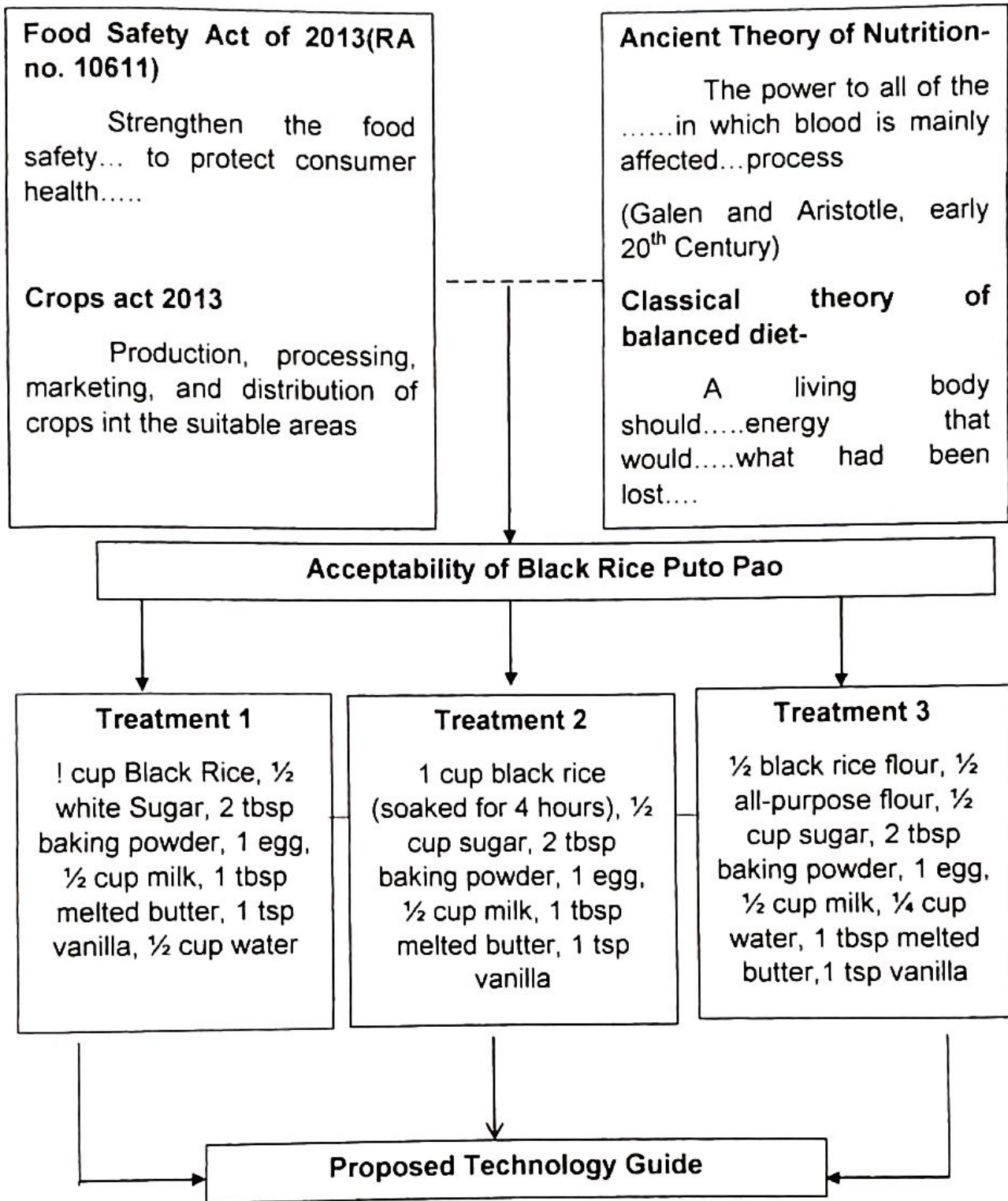
risk of diabetes, helps in weight management, reduces the growth of cancer, boost cognitive function and increases the quality of life. Hence, black rice is an excellent alternative to white and brown rice due to its nutrient density, high fiber content, and rich antioxidant content.

According to Balasubramaniam (2019), the health properties of black rice are experimentally renowned, and gathered empirical data regarding the physiological and pharmacological activity of black rice remarkably supports the use of black rice in nutritional therapy.

According to Dias et al. (2017), black rice has been consumed for centuries in Asian countries such as China, Korea, and Japan. Extracts and derivatives are considered beneficial functional foods because of their high content in several bioactive molecules such as anthocyanins, other phenolics, and terpenoids. For black rice extracts, protection against osteoporosis has been suggested for the first time. Because of its antioxidant and anti-inflammatory properties, black rice protects the liver and kidney from injuries. One clinical study reported the interest in black rice in case of alcohol withdrawal.

With around 80 percent of its total land area intended for agriculture, Braulio E. Dajuli. A town in Davao del Norte located in barangays of Cabayangan, New Casay, Dujali, and Magupising has two cropping seasons a year with an average production of 215 metric tons lead in producing organically-grown black rice. With a total of 9,100-hectare agricultural land area, around 2,000 hectares are devoted to rice production (SunStar Philippines, 2015)

The theoretical and conceptual framework of the study is presented in Figure 1. This was based on Republic Act No. 10611, also known as the "Food Safety Act of 2013". It is anchored on the Ancient Theory of Nutrition by Galen and Aristotle (early 20th Century), which considered nutrition a vital part of health, disease, performance, and healing. With this implementation, the researchers aimed to determine the teachers' and students' perceptions of the acceptability of black rice *Oryza sativa L. indica* puto pao. The Grade 12 Senior High School students and faculty members of Sierra-Bullones Technical Vocational Highschool were chosen as respondents to the study.



**Figure 1. Theoretical Conceptual Framework**

## THE PROBLEM

### Statement of the Problem

The study's main thrust was to evaluate black rice's acceptability in making a puto pao.

Specifically, the study aimed to determine the following:

1. What is the profile of the black rice puto pao terms of:
  - 1.1 ingredients used and cost;
  - 1.2 tools and equipment used; and
  - 1.3 procedure applied?
2. What is the acceptability level of black rice puto pao in terms of;
  - 2.1 appearance;
  - 2.2 aroma
  - 2.3 taste
  - 2.4 texture; and
  - 2.5 over-all acceptability?
3. Is there a significant difference in the acceptability of black rice puto pao in different treatments?
4. What technology guide maybe proposed based on the result of the study?

### Null Hypothesis

There is no significant difference in the acceptability of black rice *Oryza sativa L. indica* puto pao.

## Significance of the Study

The researchers believed that the results of this study would provide valuable information to the following individuals:

**Entrepreneurs.** Another variety of puto pao would be created, which will give entrepreneurs ideas for gaining extra income.

**T.L.E. Students.** The techno-guide would help make puto for the students and other puto enthusiasts.

**T.L.E. Instructor.** The techno-guide would be a big help to teachers in their instruction in making puto using black rice.

**Community.** This study would help the community to utilize the production of black rice.

## RESEARCH METHODOLOGY

### Design

The researchers used the quasi-experimental research method to ascertain the respondents' preferences regarding the appearance, aroma, taste, texture, and overall acceptability of black rice puto pao. Puto pao with different treatments was evaluated using a 4-point hedonic rating scale.

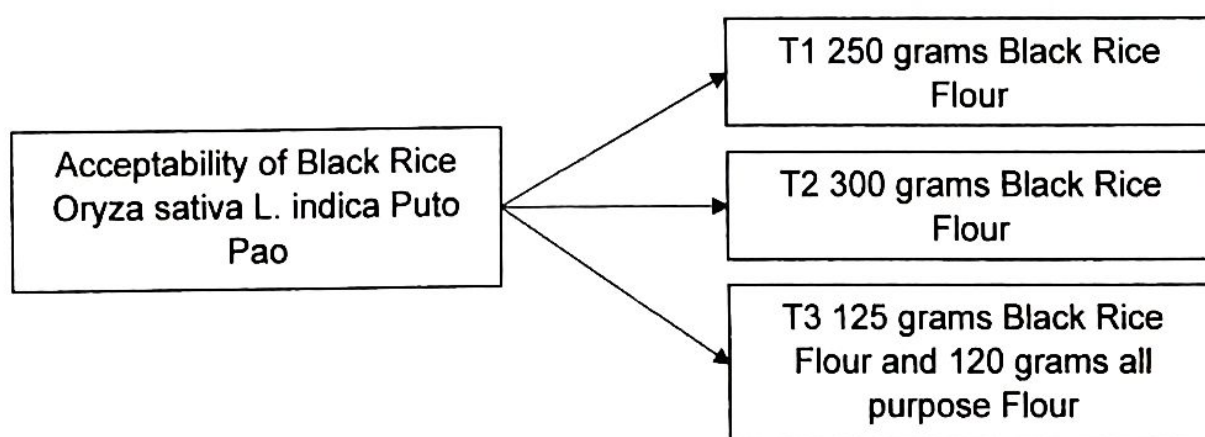


Figure 2. Experimental Layout of the Study

treatments was evaluated using a 4-point hedonic rating scale.

### Environment and Participants

The study was conducted in Sierra-Bullones Technical Vocational School.

The participants consisted of 10 faculty members and 30 students.

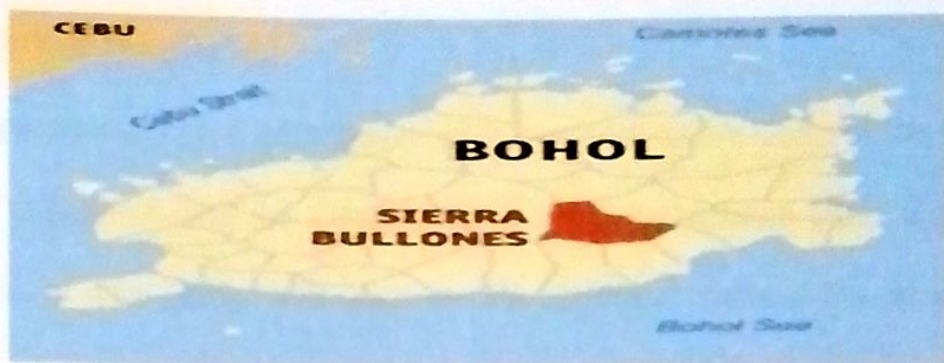


Figure 3. Location Map of the Environment and Participants.

### Instrument

The researchers utilized the observation guide adopted and modified from the study of Cadenas et al. (2021) entitled, "Acceptability of Apali Masareal". A 4-point hedonic scale was used to determine the level of acceptability of black rice puto pao, where 1 is the lowest and 4 is the highest point for the particular characteristic. The characteristics on which the puto pao were evaluated included appearance, taste, texture, aroma, and overall appearance. The questionnaire was presented to the respondents for them to answer. Moreover, a 4-point hedonic scale was used to identify the rate and sensory preference of the participants with the following rating:

Scale	Ranges of Score	Level of Acceptability
1	1.00-1.74	Not Acceptable
2	1.75-2.49	Less Acceptable
3	2.50-3.24	Moderately Acceptable
4	3.25-4.00	Highly Acceptable

## Data Gathering Procedures

### Phase 1: Permit Acquisition

Before conducting, a permission letter was sent to the Dean of the College of Teacher Education and the Campus Director. A permission letter explaining the purpose of the study was sent to the Principal before the study was conducted.

### Phase 2: Product Formulation

Essential tools and equipment such as puto molder, measuring cup, knife, mixing bowls, ladle, gas range, steamer, so with the ingredients; water, sugar, black rice, egg and flour and for filling chicken breast, onion, soy sauce, brown sugar, cooking oil, cornstarch, pepper was gathered for product formulation. The black rice was grounded and pulverized. The ingredients were mixed and molded using a puto molder and steam with moderate heat.

After attaining the right texture, the puto was placed on a separate plate. A lot of trial and error was made to attain the suitable characteristics of the puto that suit the respondents' taste preferences.

### Phase 3: Product Evaluation

The black rice puto pao was distributed to the respondents. Instructions were clearly explained to the respondents before tasting the product.

Respondents were given enough time to answer the questionnaire to attain the right and honest assessment. Each of them was provided with a sample that they rated and assessed right after tasting the puto according to their taste preference.

### Statistical Treatment

In determining the acceptability level of the black rice puto pao, the weighted mean was used with the formula:

$$WM = \frac{f_1x_1 + F_2x_2 \dots f_nx_n}{f_1 + f_2 \dots + f_n}$$

The results of the computed mean were interpreted using the following scale:

Numerical Rating	Description
3.25 – 4.00	Highly Acceptable
2.50 – 3.24	Moderately Acceptable
1.75 – 2.49	Less Acceptable
1.00 – 1.74	Not Acceptable

A One-Way ANOVA test was used to determine the significant difference in participants' acceptability in the different treatments of black rice in making puto pao in terms of its appearance, aroma, taste, and texture.

$$f = \frac{S^2_B}{S^2_W}$$

$$s^2_B = \frac{\sum n_i(\bar{x}_i - \bar{x}_{GM})^2}{k - 1}$$

$$s^2_W = \frac{\sum(n_i - 1)s_i^2}{\sum(n_i - 1)}$$

where,

$s^2_B$  = between-group variance

$s^2_W$  = within-group variance

$$\bar{x}_{GM} = \frac{\sum x}{N}$$

d.f.N. = k-1 where k= number of groups

d.f.D. = N-k where N=  $n_1 + n_2 + \dots + n_k$

## DEFINITION OF TERMS

The terms used this study are limited to the operational definitions explained herewith.

**Acceptability.** A condition where something is being approved based on someone's preference.

**Appearance.** The overall presentation of the product.

**Aroma.** The pleasant smell of the product.

**Black Rice.** The main ingredients of the product.

**Overall Acceptability.** The total acceptability of the puto expressed in aroma, appearance, taste and texture.

**Puto Pao.** The product of steaming black rice with fillings.

**Steaming.** The process of cooking puto by heating it in steam.

**Taste.** The reaction of your taste buds of the food that you have eaten.

## Chapter 2

### **PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA**

This chapter deals with the presentation, analysis, and interpretation of data gathered based on the information given by the faculty and students of Sierra-Bullones Technical Vocational High School on the acceptability of black rice puto pao. It presents the product profile in terms of ingredients used and cost, tools and equipment used, and procedure applied. It includes the table that reflects the acceptability of black rice puto pao in terms of appearance, aroma, taste, texture, and overall acceptability.

#### **Profile of the Black Rice Puto Pao**

##### **Ingredients and Cost**

The essential ingredients of a puto pao are all-purpose flour/cake flour, baking powder, sugar, butter, egg, evaporated milk, and water. Instead of all-purpose flour/cake flour as the main ingredient, the researchers introduced black rice as a substitute for all-purpose flour/cake flour. Introducing and substituting the new main ingredient promotes the usefulness of black rice, considered one of the crops that can give several benefits to the body.

##### **Tools and Equipment**

The researchers used the following tools and equipment in preparing and cooking black rice puto pao; mixing bowl, tablespoon, ladle, measuring cup, knife, steamer, gas range, frying pan, chopping board, plates, measuring spoon, and puto molder.

**Table 1.1**  
**Ingredients and Cost of Black Rice (*Oryza sativa L. indica*) Puto Pao**

QTY	Unit	Ingredients	Unit Cost	Total Cost		
				T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
250	grams	Black Rice flour	80/1000g	Available		
300	grams	Black Rice flour	80/1000g		Available	
125	grams	Black Rice flour	80/1000g			Available
120	grams	All-purpose Flour	40/1000g			40
121	grams	Evaporated Milk	30/390g	30	30	30
100	grams	White Sugar	15/250g	15	15	15
20.7	grams	Baking Powder	15/50g	15	15	1
15.1	grams	Butter (melted)	58/200g	58	58	58
50	grams	Egg	7/1000g	7	7	7
26	grams	Oil	32/375g	32	32	32
118	grams	Water	25/1000g	Available	Available	Available
60	grams	Soy Sauce	12/1000g	12	12	12
8	grams	Cornstarch	3/1000g	3	3	3
53.3	grams	Brown Sugar	13/250g	13	13	13
75	grams	Onion	7/1000g	7	7	7
174	grams	Chicken Breast	65/220g	65	65	65
1	gram	Pepper	3/1000g	3	3	3
		<b>Cost of Ingredients</b>		<b>₱242</b>	<b>₱242</b>	<b>₱280</b>
		<b>Labor Cost 30%</b>		<b>₱72.6</b>	<b>₱72.6</b>	<b>₱84</b>
		<b>Fuel</b>		<b>₱40</b>	<b>₱40</b>	<b>₱40</b>
		<b>Total Cost</b>		<b>₱354.6</b>	<b>₱364.6</b>	<b>₱404</b>
		<b>Yield or Number of Pieces</b>		<b>27</b>	<b>27</b>	<b>29</b>
		<b>Price per Piece</b>		<b>₱13</b>	<b>₱13</b>	<b>₱13.9</b>

## Procedures

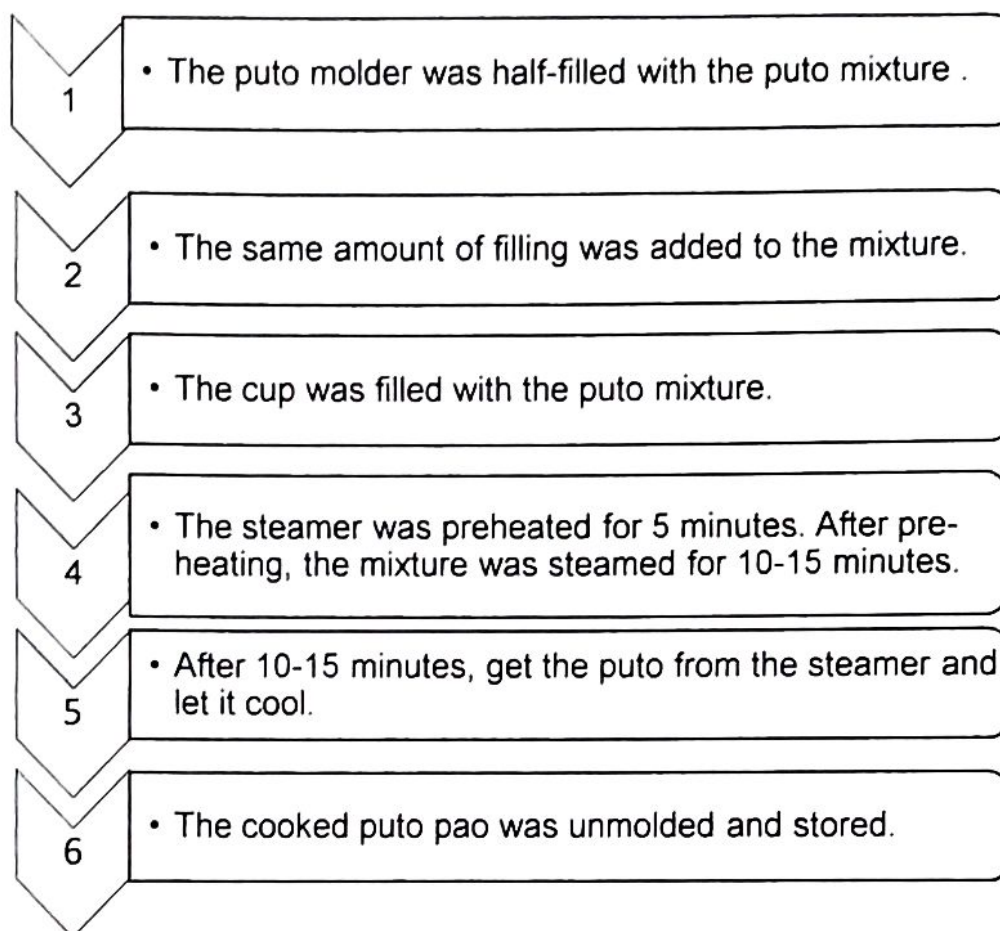
### Preparation of Black Rice Puto Pao

- 1 • The ingredients, tools and utensils needed were gathered.
- 2 • All ingredients were measured..
- 3 • The all-purpose flour and black rice flour were sifted.
- 4 • The all-purpose flour to the black rice flour were mixed..
- 5 • The baking powder was added to the previous dry mixture and was mixed well.
- 6 • Eggs were added to the mixed powders.
- 7 • The evaporated milk was added after the egg.
- 8 • Water was added to the mixture..
- 9 • Sugar was gently added while mixing.
- 10 • The melted butter was added making sure that it was already cooled.
- 11 • Oil was added to the mixture.
- 12 • Vanilla extract was added to the mixture for the aroma.

## Preparation for the Fillings

- 1 • The chicken breast was cut to mince.
- 2 • The onion was cut to mince.
- 3 • Oil was added on the preheated pan.
- 4 • The onion was sauteed once the oil was already hot.
- 5 • When onion was already golden brown, the minced chicken was added.
- 6 • Soy sauce was added for color and taste.
- 7 • Brown sugar was added to have sweetness.
- 8 • Pepper was added next for flavor.
- 9 • After the ingredients were added, cornstarch was added lastly so the filling become sticky.
- 10 • The filling was set aside and cooled..

## Preparation for the Puto Pao



**Table 1.2**  
**Tools and Equipment Used**

Unit	Tools and Equipment
2 pieces	Mixing Bowl
1 piece	Tablespoon
1 Piece	Ladle
1 set	Measuring Cup
1 piece	Knife
1 piece	Steamer
1 unit	Gas Range
1 piece	Frying Pan
1 piece	Chopping Board
5 pieces	Plate
1 set	Teaspoon
1 set	Measuring Spoon
25 pieces	Puto Molder

## Acceptability of Black Rice Puto Cheese

The most common ingredient puto in Bohol is usually made out of all-purpose flour. On the other hand, this study ventures on using black rice as an alternative flour in puto pao preparations and identifies whether this product is acceptable to people's taste buds. The acceptability of food products is anchored to their appearance, aroma, taste, texture, and overall liking.

Appearance refers to the product's attribute that attracts the consumer to eat or buy a product. It is the act of appearing as to eyes or mind before the public: the sensory or phenomenal aspect of existence to the observer (Flexner, 1993). It is the outward aspect of anything (Webster, 1913). Treatment 2 got the highest rating of 3.63% because black rice is originally black, and based on the result, (T2), which is soaked for 4 hours, has the appearance of black that originates the black rice which the respondent most preferred. Treatment 1 is colored as violet, which has 3.15% for which the plain black rice flour mixed directly with the ingredients without soaking, while treatment 3 got only 2.18% is colored as gray because the amount of black rice flour is divided by the amount of all-purpose flour.

**Table 2**  
**Acceptability Level of Black Rice (*Oryza sativa L. indica*) Puto Pao**

Treatment	Appearance	Aroma	Taste	Texture	Overall Acceptability
1	3.15	3.45	3.23	3.33	3.45
2	3.63	3.23	3.28	3.15	3.3
3	2.18	3.8	3.45	3.68	4.55

**Legend**

	Appearance	Aroma	Taste	Texture	Acceptability
1.00-1.75	White	Not Pleasant	Not Sweet	Soft	Not Preferable
1.75-2.49	Gray	Slightly Pleasant	lightly Sweet	Slightly Soft	Preferable
2.50-3.24	Violet	Pleasant	Sweet	Soft	Moderately Preferable
3.25-4.00	Black	Very Pleasant	Very Sweet	Very Soft	Highly Preferable

Aroma is the word for a fragrant scent that takes places the nose in a way that makes you lick your lips. According to Keeffe (2019), aromas play a central role in our perception of food. After catching the sight appeal of the product, consumers' direct drive is the aroma of the product. The product could not be seen, but its smell will attest to the melting or disagreeable flavor it contained. Its aroma will reveal the flavor even without seeing the product. In terms of aroma, Treatment 3 has the highest rate of 3.8%, which is described as "very pleasant", followed by treatment 1 with a rate of 3.45%, described as 'very pleasant, and treatment 2 has the lowest rate of 3.23% which described as 'pleasant'. This implies that treatment 3 is the most preferable to the respondents because of its pleasant smell. It is aromatic to all treatments when added all-purpose to the ingredients.

On the other hand, Drummond (2004) stated that taste is the sensation perceived by the taste buds on the tongue. It is one of the attributes of flavor with the distinctive taste of something experienced in the mouth. A substance or extract provides a particular taste (Fexner, 1993; 732). Treatment 3 got the highest rating of 3.45%, followed by treatment 2 with a rate of 3.28%, while treatment 1 got only 3.23%, described as pleasant. The amount of black rice flour and all-purpose flour used with sweetened fillings affects the product's sweetness. This denotes that Treatment 3 was highly preferred by the respondents because it has a very sweet taste.

Texture contributes to the appeal of the food that induces the consumer's appetite. It is the mouth feel or the product's water activity, such as hard, crisp,

soft, fine, or grainy. It is the visual or tactile surface characteristics and appearance of something, a basic structure (Mish, 2003). Treatment 3 got the highest rate of 3.68%, which is half black rice flour has a very soft texture because of the presence of all-purpose flour in the ingredients. While treatment 2, with a rate of 3.15%, has only a soft texture because black rice flour, which is soaked for 4 hours, is heavy and not granulated compared to all-purpose flour, and treatment 1, with a rate of 3.33%, also has very soft texture because plain black rice flour is added to the ingredients. This implies that treatment 3 is preferable to the respondents because of its soft texture. In preparing the puto, the texture should be considered because most respondents prefer a soft texture, which is a contributing factor affecting the respondents' preferences.

Overall liking refers to the general likeness of the product. Treatment 3 has the highest rate of 4.55%, described as 'highly preferable' followed by Treatment 1, which has a 3.45% rating, which is described as "highly preferable," and treatment 2, with a rate of 3.3%, described as 'highly preferable'. This implies that all treatments are highly preferable by the respondents.

To sum it up, Treatment 3 (T3): contained  $\frac{1}{2}$  black rice flour and  $\frac{1}{2}$  all-purpose flour,  $\frac{1}{2}$  cup sugar, 2 tsp baking powder, one egg,  $\frac{1}{2}$  cup milk,  $\frac{1}{4}$  cup water, 1 tbsp melted butter, 1 tsp vanilla, has the highly preferable with 4.55% rate, followed by Treatment 1 (T1): contained 1 cup black rice,  $\frac{1}{2}$  sugar, 2 tsp baking powder, one egg,  $\frac{1}{2}$  cup milk, 1 tbsp butter melted, 1 tsp vanilla,  $\frac{1}{4}$  cup water with 3.45% rate described highly preferable and Treatment 2 (T2): contained 1 cup black rice (soaked for 4 hours),  $\frac{1}{2}$  sugar, 2 tsp baking powder,

one egg,  $\frac{1}{2}$  cup milk, 1 tbsp melted butter, 1 tsp vanilla with a 3.3% rate described as moderately preferable. Respondents mostly preferred Treatment 3, for it was the fluffiest among all treatments because of the all-purpose added.

### Significant Difference of the Treatments

Table 3 presents the difference among the three Black Rice Puto Pao treatments in terms of their attributes. The researchers used One-Way ANOVA to differentiate the three treatments. The result shows an F-value of 3.885 with a P-value of 3.885. Furthermore, since the P-value is greater than 0.05, the decision is to accept the Null Hypothesis. This implies no significant difference among the three Black Rice Puto Pao treatments, even though black rice contains higher levels of proteins, vitamins, and minerals than white rice. Black rice contains essential amino acids like lysine and tryptophan; vitamins such as vitamin B1, vitamin B2, and folic acid; it is a good source of minerals, including iron, zinc, calcium, phosphorus, and selenium. It contains the highest amount of antioxidants, protein, and dietary fiber of all rice varieties. Besides, it has phenolics, flavonoids, and anthocyanins. Antioxidants are the first line of defense against free radical damage and are critical for maintaining optimum health and well-being. These antioxidant compounds have tremendous health benefits and can reduce the risk of developing various chronic diseases. It also detoxifies the body, improves lipid profile, reduces the risk of diabetes, helps in weight management, reduces cancer growth, boosts cognitive function, and increases the quality of life. Hence, black rice is an excellent alternative to white and brown rice due to its nutrient density, high fiber content, and rich antioxidant content.

(Thanuja and Parimalavalli, 2018). According to Balasubramaniam (2019), the health properties of black rice are experimentally renowned, and gathered empirical data regarding the physiological and pharmacological activity of black rice remarkably supports the use of black rice in nutritional therapy. This implies that even though there is no significant difference in the treatments, black rice has high amounts of vitamins and minerals compared to other flour. Because of its antioxidant and anti-inflammatory properties, black rice protects the liver and kidney from injuries. Since there is no significant difference, the puto can be directly served because it is highly preferable. All treatments are excellent and easy to serve to all ages and its commercial and good service in the school canteen.

**Table 3**  
**Significant Difference of Black Rice *Oryza sativa L. indica* Puto Pao**

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	13.66401	2	6.8320	2070.686	5.82E-16	3.885
Within Groups	0.039593	12	0.0033			
Total	13.7036	14				

Legend:

P<0.05, reject the null hypothesis

## Chapter 3

### SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS.

This chapter focuses on showing the findings, giving a summary, and recommendations. The gathered data from the previous chapter were tabulated, analyzed, and interpreted.

#### Summary

The study aimed to determine the acceptability of black rice puto pao.

The study sought to determine the overall acceptability of black rice puto pao. The acceptability level was determined by its appearance, aroma, taste, and texture. Secondly, the overall acceptability of the product was also identified.

The research was conducted at Sierra-Bullones Technical Vocational School. The 40 respondents of the study included faculty members and students majoring in the food-related subject.

The product sample was distributed to every respondent. Each respondent was also given the questionnaire to be answered and was given ample time to answer the 4-point hedonic scale. Minutes were given in between the tasting of each treatment.

After having been answered by the respondents, the gathered data were analyzed and interpreted using the weighted mean. One-Way ANOVA was used to determine respondents' preference for black rice puto cheese.

## Summary of Findings

The following are the findings based on the data obtained:

### 1. Black Rice Puto Pao Profile:

#### 1.1. Ingredients and Cost

- a. All of the essential ingredients for black rice puto pao are available and can be purchased at the market, although the black rice crop is rarely available because it is sold at a higher price.
- b. Black rice puto pao in treatment 3 got the highest total cost, followed by the other two treatments, which have the same total cost.

#### 1.2. Tools and Equipment

The tools and equipment can be found at BISU-Bilar Food Laboratory and home. It can also be purchased at the market.

#### 1.3. Procedures

The procedure of making black rice puto pao needs ample time to prepare, but with the help of a detailed guide, it is easy to follow and, therefore, feasible.

2. Black rice puto pao with half all-purpose flour (T<sub>3</sub>) was primarily preferred by the respondents, rated as Highly Preferable, and can be proposed as an entrepreneurial product most of the respondents chose during the product tasting. Treatment 1 and Treatment 2 was also rated Highly

Preferable because the overall acceptability of the product was also preferred by the respondents.

3. There is no significant difference in all sensory attributes and overall acceptability among the three (3) treatments of black rice *Oryza sativa L. Indica* puto pao.

## Conclusions

The purpose of the study was to develop a puto using black rice. Black rice puto pao was made with three different treatments; Treatment 1 (T1): contained 1 cup black rice,  $\frac{1}{2}$  sugar, 2 tbsp baking powder, one egg,  $\frac{1}{2}$  cup milk, 1 tbsp butter melted, 1 tsp vanilla,  $\frac{1}{4}$  cup water. Treatment 2 (T2): contained 1 cup black rice (soaked for 4 hours),  $\frac{1}{2}$  sugar, 2 tbsp baking powder, one egg,  $\frac{1}{2}$  cup milk, 1 tbsp melted butter, and 1 tsp vanilla. Treatment 3 (T3): contained  $\frac{1}{2}$  black rice flour and  $\frac{1}{2}$  all-purpose flour,  $\frac{1}{2}$  cup sugar, 2 tbsp baking powder, one egg,  $\frac{1}{2}$  cup milk,  $\frac{1}{4}$  cup water, 1 tbsp melted butter, and 1 tsp vanilla. It was found that T3 got the highest overall acceptability among the three treatments. The equal amount of ingredients made the product more acceptable than others. Each ingredient compliments the other and makes it the most consistent treatment. However, there is no significant difference in the acceptability of the three treatments in terms of their appearance, aroma, taste, and texture. Therefore, the null hypothesis is accepted.

## Recommendations

Based on the conclusion drawn, the researchers presumed the following recommendations:

1. The Technology and Livelihood Education instructors handling food-related subjects may utilize the technology guide in the student's activity and practicum.
2. The Technology Livelihood students and the Food Technology and Entrepreneurship students could utilize black rice puto cheese in making income-generating products. The product will be utilized and introduced for community consumption to promote the product.
3. The school administration may encourage students to promote products from underutilized resources.
4. Future researchers may conduct related studies to develop more products utilizing black rice.

## Technology Guide for Black Rice *Oryza sativa L. indica* Puto Pao

### Rationale

Puto is derived from the Malay word "puttu," which means portioned. These bite-sized cakes stuffed with sweet pork or meat filling are a tribute to the Chinese meat bun. Puto pao is now becoming a popular snack among Filipinos and does the great business too. It only needs small capital to start and is easy to make. If one is an excellent business-minded, this might turn one into a millionaire or cook this for the family.

Black rice, also called purple rice, forbidden rice, and Chinese black rice, is a type of whole-grain rice that is quite dark in color. It can be completely black, darker purple, or burgundy with multicolored kernels. When black rice is cooked, it turns dark purple. Black rice gets its dark color from the antioxidant called anthocyanin. Black rice tastes very similar to brown rice and is often described as having a "nutty" flavor. It is pretty dense and chewy. Depending on the cooking method, black rice can also be quite sticky. Black rice is very nutritious. It is high in antioxidants, protein, and fiber and is a good source of iron. (MasterClass, 2021)

Nonetheless, black rice contains the highest amount of antioxidants, protein, and dietary fiber of all rice varieties. One serving of black rice (1/4 cup or 50g) contains approximately 160 calories. Each serving of this type of rice contains 5g of protein and 2g of fiber, and 1g of iron. Both brown rice and black rice contain vitamins, minerals, and dietary fiber. However, black rice is superior to brown rice because it contains more protein and fiber than brown rice

Moreover, black rice has an extremely high antioxidant content, which provides many additional health benefits (Thanuja & Parimalavalli, 2018).

In this connection, the researchers are motivated to innovate a new type of puto pao utilizing black rice as a featured ingredient of the product development. Thus, the study on the acceptability of black rice (*Oryza sativa L. indica*) puto pao.

## II. Objectives

The objectives of the proposed technology guide are the following:

1. To enhance the quality of the product;
2. To ensure that new invented food is safe for future consumption;
3. Black Rice Puto Pao will be introduced to the community;
4. To take advantage of the richness of natural resources in the area and create something new that benefits both the school and the community, and
5. Increase farmer revenue through boosting agricultural resources.

## III. Ingredients, Tools and Equipment and Procedure.

In making the Black Rice Puto Pao needs the following ingredient, tools and equipment, observing the proven procedural test.

### A. Puto Batter Ingredients



1c Black rice Flour



1c All-purpose Flour



1c Evap Milk



2tbsp Oil



1c White Sugar



1tsp Vanilla



1/2c Water

1/8c Melted Butter

2tbsp Baking Powder



2 Eggs

**B. Asado Filling Ingredients**

1 Chicken Breast



3tbsp Soy Sauce



2tsp Cornstarch



1pcs Onion



1/4c Brown Sugar



Ground Black Pepper

#### IV. Cost Accounting for One Formulation of Black Rice *Oryza sativa L.* *indica* Puto Pao

QTY.	Unit	Ingredient	Unit Cost	Total Cost
250	grams	Black Rice	60/1000g	60
120	grams	All-purpose Flour	40/1000g	40
100	grams	White Sugar	15/250g	15
121	grams	Evaporated Milk	30/300g	30
20.7	grams	Baking Powder	15/1000g	15
15.1	grams	Butter (melted)	58/200g	58
26	grams	Oil	32/375g	32
50	grams	Egg	7/1000g	7
60	grams	Soy Sauce	12/100g	12
118	grams	Water	25/1000g	25
8	grams	Cornstarch	3/1000g	3
53.25	grams	Brown Sugar	13/150g	1
75	grams	Onion	7/1000g	7
174	grams	Chicken Breast	65/220g	65
1	gram	Pepper	3/1000g	3
			<b>Cost of Ingredients</b>	<b>₱373</b>
			<b>Labor Cost (30%)</b>	<b>₱111.9</b>
			<b>Fuel</b>	<b>₱40</b>
			<b>Total Cost</b>	<b>₱524.9</b>
			<b>Yield or Number of Piece</b>	<b>30</b>
			<b>Price per Piece</b>	<b>₱17.5</b>

#### C. Tools and Equipment



Mixing Bowl



Measuring Cup



Tablespoon



Knife



Plate



Ladle

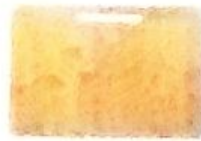


Sifter



Wire Whisk

Puto Molder



Chopping Board

Steamer










Gas Range








#### D. Procedure




##### 1. Preparation for Battered Mixture.

1. Gather all the ingredients, tools and utensils needed	
2. Measure all the ingredients	
3. Sift the all-purpose flour and black rice flour.	
4. Mix the all-purpose flour to the black rice flour.	
5. Then add the baking powder and mix it well.	




<p>6. After mixing, put the eggs to the mixture.</p>	
<p>7. Add the evaporated milk next to egg.</p>	
<p>8. Add water to the mixture.</p>	
<p>9. Gently add the sugar while mixing.</p>	
<p>10. Add the melted butter. Make sure that the butter is not hot from melting.</p>	
<p>11. Next, add the oil to the mixture.</p>	
<p>12. Add the vanilla extract to add aroma to the mixture.</p>	




## 2. Preparation for the Fillings.

<p>1. Cut the chicken breast to mince.</p>	
<p>2. Cut the onion to mince.</p>	
<p>3. On a preheat pan, put the oil.</p>	
<p>4. Once the oil is heated, put the onion.</p>	
<p>5. When the onion is colored golden brown, add the minced chicken.</p>	
<p>6. Put soy sauce to add color and taste.</p>	
<p>7. Add brown sugar to have sweetness, the taste of your fillings depends on your liking.</p>	

<p>8. After adding the sugar, next is the pepper to add flavor.</p>	
<p>9. After putting the necessary ingredients, add the cornstarch in order to become sticky.</p>	
<p>10. Set aside the fillings.</p>	

### 3. Preparation for the Puto Pao.

<p>1. Fill only half of the puto molder.</p>	
<p>2. Add the same amount of fillings to the mixture.</p>	
<p>3. Full the cup with the mixture.</p>	

<p>4. Pre-heat the steamer for 5 minutes. After pre-heating put the mixture in the steamer and wait for 10-15 minutes.</p>	
<p>5. After 10-15 minutes get the puto from the steamer and let it cool.</p>	
<p>6. Unmold and Serve it!</p>	

## REFERENCES

- 1987 Phil. Constitution **Article II, Section 15** (n.d). Manila LawPhil.
- 1987 Phil. Constitution **Article XIV, Section 10** (n.d). Manila LawPhil.
- Baker L. (2018). **Puto: Filipino Steamed Rice Cakes**. Retrieved from November 1, 2021 from (<https://kitchenconfidante.com/puto-filipino-steamed-rice-cake-recipe>).
- Balasubramaniam J., et.al. (2019). **Health benefits of black rice-A review**. *Grain & Oil Science and Technology* 2(4). Retrieved on: June 27, 2021 from: ([https://www.researchgate.net/publication/336655176\\_Health\\_benefits\\_of\\_black\\_rice\\_-\\_A\\_review](https://www.researchgate.net/publication/336655176_Health_benefits_of_black_rice_-_A_review))
- Brennan, MD. (2020). **Black Rice: Health Benefits, Nutrition, and Uses**. Retrieved from April 27, 2022 from (<https://www.webmd.com/diet/health-benefits-black-rice> ).
- Cadenas et, al. **Acceptability of Apali (*Dioscorea esculenta*) Masareal; A Proposed Techology Guide**. Retrieved from BISU-Bilar Campus Library.
- Dias, A., et.al.(2017). **Recent advances on bioactivities of black rice**. Volume 20 - Issue 6 - p 470-476. Retrieved on: June 27, 2021 from:([https://journals.lww.com/coclinicalnutrition/Abstract/2017/11000/Recent\\_advances\\_on\\_bioactivities\\_of\\_black\\_rice.8.aspx](https://journals.lww.com/coclinicalnutrition/Abstract/2017/11000/Recent_advances_on_bioactivities_of_black_rice.8.aspx))
- Drummond, (2004.) **The Secret to Getting Comfortable in the Kitchen**. (<https://www.tasteofhome.com/article/the-secret-to-getting-comfortable-in-the-kitchen-according-to-ree=drummond/>)
- Endang, R. W., Moses, L.S. 1 Ketut, G. (2014). **Production System in Food Industry: A Literature Study**. Retrieved February 27, 2021 from [<http://www.researchgate.net/publication/3240063>].
- Flexner, 1993 **Taste, Texture, Smell or Appearance: Which is more important in overall liking?** (Taste, texture, smell or appearance: Which is most important in overall liking? (foodnavigator.com))
- Hendrick, B. (2010). **Black rice is cheap way to get antioxidant**. Retrieved on: June 27, 2021 from: (<https://www.webmd.com/foodrecipes/news/20100826/black-rice-is-cheap-way-to-get-antioxidants>an>)

- Keeffe P. 2019. **Smelling Our Way to Tastier Foods**  
(<https://www.healthline.com/health-news/smelling-our-way-to-tastier-foods>)
- Kushala, G. Sreenivas., et.al. (2017). **Product Development Acceptability and Cost Effectiveness of Jackfruit Jam Blended with Avocado and Kokum**. Retrieved April 27, 2021 from [<http://www.phytojournal.com>].
- MasterClass staff. (2021). **The Secret Behind Forbidden Rice: All About Black Rice, Plus a Simple Black Rice Recipe**. Retrieved March 1, 2022 from (<https://www.masterclass.com/articles/the-secret-behind-forbidden-rice-all-about-black-rice-plus-a-simple-black-rice-recipe>).
- Navarro et. Al (2016). **Acceptability of Water Chestnut Flour in “Puto” Making**. Retrieved from April 27, 2022 from (<https://sajst.org/online/index.php/sajst/article/view/8>).
- Panlasang Pinoy Recipes, 2012. **Puto Pao Recipe**.  
<https://www.panlasangpinoyrecipes.com/puto-pao-with-salted-egg-recipe/>
- R.A No. 10611. **Food Safety Act of 2013**  
(<https://www.officialgazette.gov.ph/2013/08/23/republic-act-no-10611/>)
- R.A No. 10557. **Philippine Design Competitiveness Act of 2013**  
(<https://www.officialgazette.gov.ph/2013/05/15/republic-act-no-10557/>)
- Simrandeep, Kour., et.al., (2018). **Strategies on Conservation, Improvement and Utilization of Underutilized Fruit Crops**. Retrieved March 7, 2021 from [<http://www.ijcmas.com>].
- SunStar Philippines, 2015. **Growing organic black rice**.  
(<https://www.sunstar.com.ph/article/28560/growing-organic-black-rice>)
- Thanuja, and Parimalavalli, (2018). **Role of Black Rice in Health and Diseases. International Journal of Health Sciences and Research. Volume 8. Issue 2. P. 241**. Retrieved on : June 27, 2021 from: (<https://www.ijhsr.org>)
- Ullah, N., Ullah, S., Khan, A., Ullah, I., Badshah, S. (2018). **Preparation and Evaluation of Carrot and Apple Blended Jam**. Retrieved February 27, 2021 from [<http://www.longdorm.org>].

Webster 1913. **Appearance**

(<http://www.webster-dictionary.org/definition/appearance>)

Young, M. et al, (2019). **Black Rice (*Oryza sativa* L.) Fermented with *Lactobacillus casei* Attenuates Osteoclastogenesis and Ovariectomy-Induced Osteoporosis.** Retrieved on: June 27, 2021 from: (<https://doi.org/10.1155/2019/5073085>)

## **APPENDICES**



## APPENDIX A

Republic of the Philippines  
BOHOL ISLAND STATE UNIVERSITY- BILAR  
Zamora, Bilal, Bohol



## Sensory Evaluation Form

ACCEPTABILITY OF BLACK RICE *Oryza sativa L. indica* PUTO PAO

Name: (Optional) \_\_\_\_\_

Date: \_\_\_\_\_

Age: \_\_\_\_\_

Sex: \_\_\_\_\_

**Instruction:** Please evaluate the following food sample products presented. Indicate the numerical rating of each sensory attributes for the three (3) treatments.

**Legend:****Appearance**

4-Black

3-Violet

2-Gray

1-White

**Aroma**

4-Very Pleasant

3-Pleasant

2-Slightly Pleasant

1-Not Pleasant

**Taste**

4-Very Sweet

3=Sweet

2-Slightly Sweet

1-Not Sweet

**Texture**

4=Very Soft

3= Soft

2-Slightly Soft

1-Not Soft

**Over-all Acceptability**

4-Highly Preferable

3-Moderately Preferable

2-Preferable

1-Not Preferable

Sensory Attributes	Treatments		
	1	2	3
Appearance			
Aroma			
Taste			
Texture			
Overall Acceptability			

Comments/Suggestions:

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Thank you very much!

The Researchers

## APPENDIX B



Republic of the Philippines  
**BOHOL ISLAND STATE UNIVERSITY- BILAR**  
 Zamora, Bilar, Bohol



*Vision: A premier S & T university for the formation of a world class and virtuous human resource for sustainable development in Bohol and the country.*

*Mission: Committed to provide quality higher education in the arts and sciences, as well as in the professional and technological fields; undertake research and development, and extension services for the sustainable development of Bohol and the country*

December 10, 2021

**MARIETTA C. MACALOLOT, PhD**

Campus Director  
 BISU – Bilar Campus  
 Zamora, Bilar, Bohol

Madam:

The undersigned BTLEd IV students major in Home Economics of this institution humbly request permission from your office to conduct a research entitled, “**ACCEPTABILITY OF BLACK RICE *Oryza sativa L. indica* PUTO PAO**”, in partial fulfillment of the requirements for the degree of Bachelor of Technology Livelihood Education (BTLEd) major in Home Economics.

In this regard, we humbly request permission from your good office to allow us to conduct our pilot testing of our study among randomly selected Bachelor of Technology Livelihood Education (BTLEd) major in Home economics students and teachers of this institution through tasting of our products and distribution of questionnaires.

Rest assured that Inter-Agency Task Force (IATF) COVID-19 health protocols will be observed and the data gathered will be kept confidential.

May this request merit your approval.

Thank you!

Very respectfully yours,

(Sgd.) **SEAN STEVEN H. TINAJA**  
 (Sgd.) **FRITZ LOUIE S. NAYVE**  
 (Sgd.) **EDCEL N. CORONEL**  
 Student Researchers

Noted:

(Sgd.) **JENELYN C. ANCOG**  
 Research Adviser

Recommending Approval:

(Sgd.) **ADORACION P. QUITORAS, EdD** (Sgd.) **MA. QUIMAR Q. GAHIT, EdD.**  
 Chairperson, DGEEd Dean, College of Teacher Education

Approved by:  
 (Sgd.) **MARIETTA C. MACALOLOT, PhD**  
 Campus Director



Republic of the Philippines  
**BOHOL ISLAND STATE UNIVERSITY- BILAR**  
 Zamora, Bilar, Bohol



*Vision: A premier S & T university for the formation of a world class and virtuous human resource for sustainable development in Bohol and the country.*

*Mission: Committed to provide quality higher education in the arts and sciences, as well as in the professional and technological fields; undertake research and development, and extension services for the sustainable development of Bohol and the country*

December 10, 2021

**MARIETTA C. MACALOLOT, PhD**

Campus Director  
 BISU – Bilar Campus  
 Zamora, Bilar, Bohol

Madam:

The undersigned BTLEd IV students major in Home Economics of this institution humbly request permission from your office to conduct a research entitled, “**ACCEPTABILITY OF BLACK RICE *Oryza sativa L. indica* PUTO PAO**”, in partial fulfillment of the requirements for the degree of Bachelor of Technology Livelihood Education (BTLEd) major in Home Economics.

In this regard, we humbly request permission from your good office to allow us to conduct our study among randomly selected students in Grades 11 and 12 with specialization on Bread and Pastry and Cookery and teachers of Sierra Bullones Technical Vocational High School through tasting of our products and distribution of questionnaires.

Rest assured that Inter-Agency Task Force (IATF) COVID-19 health protocols will be observed and the data gathered will be kept confidential.

May this request merit your approval.

Thank you!

Very respectfully yours,  
 (Sgd.) **SEAN STEVEN H. TINAJA**  
 (Sgd.) **FRITZ LOUIE S. NAYVE**  
 (Sgd.) **EDCEL N. CORONEL**  
 Student Researchers

Noted:  
 (Sgd.) **JENELYN C. ANCOG**  
 Research Adviser

Recommending Approval:

(Sgd.) **ADORACION P. QUITORAS, EdD** (Sgd.) **MA. QUIMAR Q. GAHIT, EdD**  
 Chairperson, DGEEd Dean, College of Teacher Education

Approved by:  
 (Sgd.) **MARIETTA C. MACALOLOT, PhD**  
 Campus Director



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December 10, 2021

**JEFFORD S. CAÑAS, PhD.**

Principal

Sierra Bullones Technical Vocational High School

Salvador, Sierra Bullones, Bohol

Sir:

The undersigned BTLEd IV students major in Home Economics of our institution humbly request permission from your office to conduct a research entitled, "**ACCEPTABILITY OF BLACK RICE *Oryza sativa L. indica* PUTO PAO**", in partial fulfillment of the requirements for the degree of Bachelor of Technology Livelihood Education (BTLEd) major in Home Economics.

In this regard, we humbly request permission from your good office to conduct our study among randomly selected students in Grades 11 and 12 with specialization on Bread and Pastry and Cookery and teachers in your school through tasting of our products and distribution of questionnaires.

Rest assured that Inter-Agency Task Force (IATF) COVID-19 health protocols will be observed and the data gathered will be kept confidential.

May this request merit your approval.

Thank you!

Very respectfully yours,

(Sgd.) **SEAN STEVEN H. TINAJA**

(Sgd.) **FRITZ LOUIE S. NAYVE**

(Sgd.) **EDCEL N. CORONEL**

Student Researchers

Noted:

(Sgd.) **JENELYN C. ANCOG**

Research Adviser

Recommending Approval:

(Sgd.) **MA. QUIMAR Q. GAHIT, EdD**

Dean, College of Teacher Education

(Sgd.) **MARIETTA C. MACALOLOLOT, PhD**

Campus Director

Approved by:

(Sgd.) **JEFFORD S. CAÑAS, PhD**

Principal, SBTVHS



Republic of the Philippines  
**Bohol Island State University - Bilar**  
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## COLLEGE OF TEACHER EDUCATION

Dear Respondents:

We, the researchers are conducting a study entitled "**ACCEPTABILITY OF BLACK RICE *Oryza sativa L. indica* PUTO PAO**". In this connection, we do hereby ask your support in answering the questionnaire.

We sincerely hope that you would answer the questions honestly. Your cooperation is a great help in the success of our research study.

Thank you!

Sincerely yours,

(Sgd.) FRITZ LOUIE S. NAYVE

(Sgd.) EDCEL N. CORONEL

(Sgd.) SEAN STEVEN H. TINAJA

# APPENDIX C

## Black Rice and Black Rice Flour



## APPENDIX D

TECHNOLOGY GUIDE OF BLACK RICE *Oryza sativa* L *indica* PUTO PAO

Republic of the Philippines  
BOHOL ISLAND STATE UNIVERSITY



Zamora, Bilar, Bohol

# BLACK RICE PUTO PAO



## APPENDIX E

## RAW DATA

No.	Treatment 1					Treatment 2					Treatment 3				
	Ap	Ar	Ta	Te	G.A	Ap	Ar	Ta	Te	G.A	Ap	Ar	Ta	Te	G.A
1	2	3	2	2	3	4	2	2	2	3	2	3	3	3	4
2	2	2	3	3	2	4	2	2	2	3	2	4	3	3	4
3	2	2	3	3	2	4	2	3	2	2	2	4	3	3	4
4	2	2	3	3	2	4	2	3	2	2	2	4	3	3	4
5	2	2	4	3	3	4	3	2	2	2	2	3	2	3	2
6	2	3	2	3	3	4	3	3	2	3	2	4	4	4	4
7	2	3	3	2	3	4	4	4	3	3	2	3	4	4	4
8	2	3	3	4	3	2	2	2	2	2	2	3	3	4	4
9	4	4	4	4	4	3	4	3	4	4	4	4	4	3	4
10	3	3	2	2	2	2	2	3	3	3	4	4	4	4	4
11	3	2	3	3	4	4	3	2	3	4	4	4	4	4	4
12	4	4	3	4	4	1	3	2	3	4	2	4	2	4	4
13	3	3	2	3	3	2	4	3	3	2	4	4	4	4	4
14	4	3	3	2	4	4	3	3	2	4	2	4	3	3	3
15	2	4	3	3	4	2	4	3	2	4	1	4	3	4	4
16	2	3	3	3	3	4	3	3	2	3	2	3	3	4	4
17	4	3	4	4	3	4	3	3	3	3	2	4	3	4	4
18	2	3	3	3	3	4	2	2	2	2	2	3	3	3	3
19	2	2	4	3	3	4	4	3	2	3	2	2	3	4	2
20	2	3	3	3	3	4	3	2	2	3	2	3	3	3	3
21	4	4	4	4	4	4	4	4	3	4	3	4	4	4	4
22	2	3	3	2	4	4	2	3	2	3	1	4	4	4	4
23	2	3	3	2	4	4	3	2	3	4	1	3	4	4	4
24	2	3	2	2	3	4	2	2	4	2	1	3	4	4	4
25	4	4	4	3	4	3	3	3	3	3	4	3	3	3	3
26	2	3	3	2	4	3	2	2	2	3	1	2	1	4	2
27	2	3	3	3	2	4	2	3	3	3	2	3	3	3	3
28	2	3	3	3	3	4	3	3	3	3	2	3	3	3	3
29	2	3	2	2	3	4	2	1	2	2	2	3	3	3	3
30	2	3	2	2	2	4	2	2	2	2	2	3	2	3	3
31	2	3	2	2	3	4	2	2	2	2	2	3	2	3	2
32	2	3	2	1	4	4	2	3	1	4	2	2	2	2	4
33	2	4	4	2	3	4	2	2	2	2	1	3	3	4	4
34	2	3	2	2	3	4	4	3	2	4	2	2	2	4	3
35	3	3	4	3	3	4	4	3	2	3	2	3	3	3	3
36	3	3	3	4	3	4	3	3	3	3	2	4	3	3	4
37	2	3	3	3	3	4	3	2	3	2	2	3	3	3	3
38	2	2	3	4	4	4	3	3	3	4	2	3	3	4	4
39	2	2	4	4	3	4	3	3	4	3	2	3	3	4	4
40	4	2	3	3	3	4	3	4	3	3	2	4	3	4	3