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RICE EEL *(Monopterus albus)* FISHBALL FORTIFIED WITH CASSAVA - BASED SAGIP NUTRI- POWDER

Alexis Mae I. Aquino [1], Jhoan G. Simangan [1], Eduard S. Ualat [1]
Martina R. Peñalber, Ed.D. [2]
Isabela State University- Echague Main Campus, Philippines

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ABSTRACT

This study was conducted to determine the benefits of Rice Eel (Monopterus albus) Fishball Fortified with Cassava-Based SAGIP Nutri-Powder in promoting nutritious food to improve individual's health and well-being. One purpose of the study was to address and mitigate the malnutrition covered by the BIDANI among 14 barangays in the municipality of Echague, Isabela. The study involved four treatments: Treatment 1 (Commercial Fishball), Treatment 2 (50 grams CBSNP, 200 grams Rice eel flesh), Treatment 3 (100 grams CBSNP, 300 grams Rice eel flesh), and Treatment 4 (150 grams CBSNP, 500 grams Rice eel flesh, 250 grams All-purpose flour). A 9-point Hedonic Scale was used for sensory evaluation, in terms of appearance/color, aroma/odor, flavor/taste, and general acceptability. Sixty (60) respondents, categorized as students, tricycle drivers/farmers, and professionals aged 18-50 years old, served as panelist. Treatment 3 received the highest mean score across all treatments, with the quantitative description of "Like Very Much." Statistical analysis showed no significant differences among the treatments in terms of appearance/color, aroma/odor, flavor/taste, and general acceptability. However, Treatment 3 consistently received the highest ratings. The Return on Investment (ROI) analysis revealed that Treatment 2 was the most profitable for a business venture. Furthermore, the study underscores the importance of developing innovative, nutritious food products to improve public health. The development of such products can play a crucial role in improving the dietary habits and overall health of the population.

KEYWORDS: *BIDANI, CBSNP, Fishball,Fortified, Rice Eel*

INTRODUCTION

The problem and its background

In the latest trend of innovation, rice eels have been utilized and developed as food products, like rice eel longganisa, burger patties, and shanghai rolls. The increasing effort to transform this species into a valuable product got a hook by catching the attention of the researchers and food experts. Surprisingly, The rice eel *(Monopterus albus)* has been considered by the farmers as a pest, but last year it turned out to be a dollar-earner according to Jovita P., a son of the Bureau of Fisheries and aquatic Resources. Furthermore, the redirecting implication of progressive discoveries and growing technology introduce new forms of recognition into underrated sources. Along with the various and modern methods of improving current food sources.

Rosli & Sarbon (2015) state that, "swamp eels are known to have good nutrition, are tasty and used for medicinal purposes". The protein content of swamp eel flesh was 16.88%, moisture content was 83.87%, and fat content was 3.41% (Halim & Sarbon, 2017). Eel is a good source of protein, omega-3, and a wide range of vitamins and minerals. Eel provides a significant amount of vitamins A, D, and B12. It contains low levels of mercury. It can also provide a reasonable amount of omega-3 fatty acids, but there are better seafood sources (Michael Joseph, MSc, 2023).

In Eastern medicine, eel meat has the properties of orange, tonic for the spleen and stomach. The function of eel meat on the body helps to replenish damage, reduce leprosy, strengthen tendons and bones. Use eel meat for cases of tuberculosis, qi and blood, low blood pressure, postpartum hemorrhage, hemorrhagic dysentery syndrome, hemorrhoids, or physical weakness (VINMEC International Hospital)

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Cassava is an important source of food calories in the world, fulfilling a critical role as a food security crop (Haggblade, Andersson Djurfedlt, Banda Nyirenda, Bergman lodin, Brimer & Chiona, 2012). Stapleton (2012) stated that, "its roots are also one of the most important sources of commercial starch in tropical and subtropical countries. In fact, the crop is the second most important source of starch worldwide, after maize, and the most traded one". The global export of cassava starch and flour in 2014 amounted to 8.5 million tons (FAO, 2015). In South and South-East Asia, starch export has been one of the drivers of cassava expansion and 40% of the total cassava production is used for starch extraction (Fuglie, Oates & Xie, 2006). Applications of cassava starch (also known as tapioca) is found in the textile and pharmaceutical industry and within food manufacturing, for which it is well suited since it has a bland taste and produces a clear paste (Jobling, 2004; Fuglie, Oates & Xie, 2006; FAO, 2015).

The study aligned to the Sustainable Development goals which are: SDG #1 Poverty, SDG #2 Zero Hunger, SDG #3 Good Health and Wellbeing, SDG #8 Decent Work and Economic Growth, SDG #11 Sustainable Cities and Communities, and lastly SDG #12 Responsible Consumption and Production. Furtherly and sustainably focus on innovation and development.

Statement of the Problem

This study was conducted to determine the acceptability and potential benefits of Rice Eel *(Monopterus albus)* enriched with Cassava-Based Sagip Nutri-Powder Fortified with CPH, Malunggay, and Turmeric Powder through fish ball and to promote a daily healthy lifestyle.

Specifically, it aimed to answer the following questions:

1. What is the level of acceptability of the Rice Eel Fishball fortified with Cassava-Based SAGIP Nutri-Powder in terms of appearance/color, aroma/odor, taste/flavor, and general acceptability?
2. What is the difference in acceptability levels among the four treatments of Rice Eel Fishball based on the evaluated sensory attributes?
3. What is the most preferred among the four treatments?
4. What is the Return on Investment (ROI) computed for the different treatment ?

METHODOLOGY

Materials and Equipment

The study used different kitchen utensils in making Rice Eel Fishball such as chopping board, Frying pan, knife, mixing bowl, whisk, disposable gloves, colander, blender, weighing scale, measuring tools.

Experimental Design and Treatments

This research was experimental type. This study was conducted with four (4) treatments.

The data and other information were presented, treated and analyzed using the experimental design in comparing the groups under the observation of this research.

In this research, the ratios of ingredients for Rice Eel Fish Ball remained consistent, except for the main components, namely rice eel and the binding agents, which include all-purpose flour, and egg white. Different ratios of Cassava-Based SAGIP Nutri- Powder were used as a fortification in making Rice Eel Fishball.

The treatments are the following:

Treatment 1

200 grams Galunggong fish, 150 grams All purpose flour, 15 grams cornstarch, 5 grams of garlic and onion powder, 12 grams ground pepper, 66 grams egg white, 500 grams oil and 24 grams salt.

Treatment 2

200 grams Rice eel flesh, 50 grams Cassava- Based SAGIP Nutri- Powder, 150 grams APF, 15 grams cornstarch, 15 grams garlic and onion powder, 12 grams ground pepper, 66 grams, 500 grams oil, 24 grams salt.

Treatment 3

300 grams rice eel flesh, 100 grams Cassava- Based SAGIP Nutri- Powder, 200 grams APF, 15 grams cornstarch, 15 grams garlic and onion powder, 12 grams ground pepper, 66 grams egg white, 500 grams oil, 24 grams salt.

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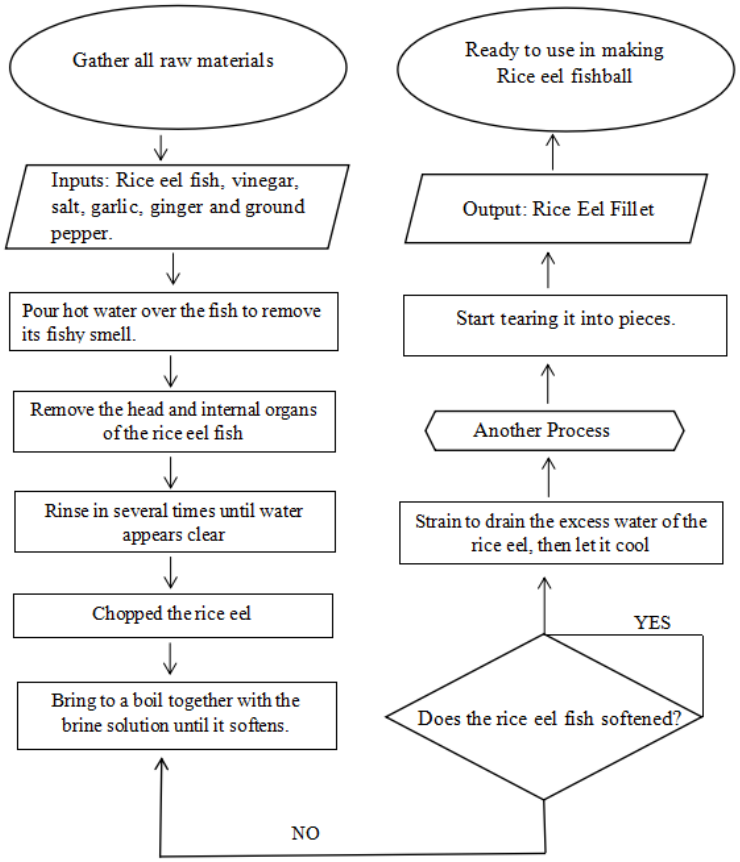
Treatment 4

500 grams rice eel flesh, 150 grams Cassava- Based SAGIP Nutri- Powder, 250 grams APF, 15 grams cornstarch, 15 grams garlic and onion powder, 12 grams ground pepper, 100 grams egg white, 500 grams oil, 24 grams salt

Processing Procedure

1. **Preparation of Rice Eel Fillet**



Pour hot water over the fish to remove the fishy smell. Remove the head and internal organs of the rice eel fish. Chop the rice eel into small pieces then bring to a boil together with the brine solution until it softens. Strain to drain the excess water of the rice eel, then let it cool. Remove the fishbones, then start tearing it into pieces.

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2. Preparation in Making Rice Eel Fishball

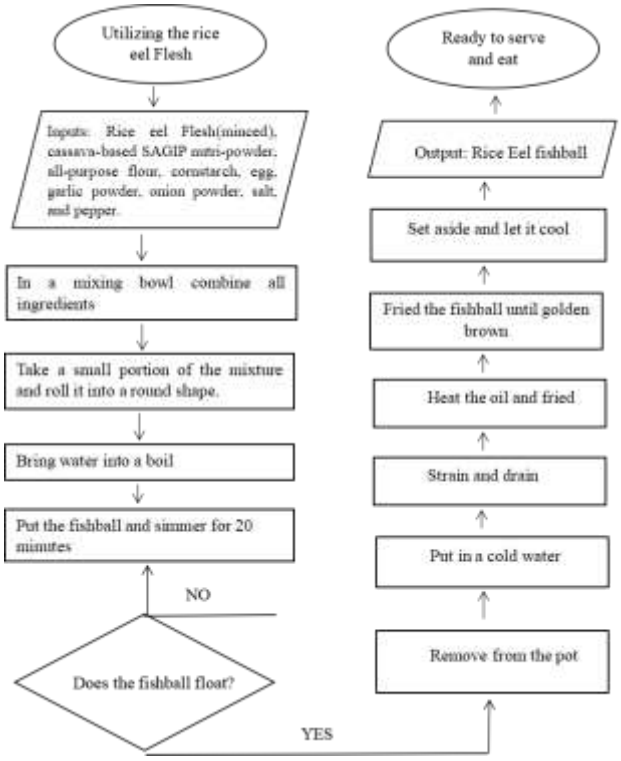

Figure 2. Process on making Rice Eel Fishball

The rice eel fishball were prepared using the proportion given in the treatments above.
In a mixing bowl, mix together the all-purpose flour, Cassava- Based SAGIP Nutri- Powder, cornstarch, salt, onion powder, one by one into a separate small bowl, beat them until frothy, then add them to the combined dry ingredients. Stir the mixture thoroughly until it is uniform. Incorporate this combined mixture into the rice eel paste, then mix it thoroughly. Make small portions of the mixture and shape them into round shapes. Repeat this process until all of the mixture is used.

Fill a large bowl with water and place it in a pot. Place the pot on the stove and warm the water until it reaches a lukewarm temperature. Submerge the fish balls in the lukewarm water in the pot and simmer them for 20 minutes. Once done, take the fish balls out of the pot and place them in a strainer to cool down. In a separate frying pan, add oil and heat it up before cooking the boiled fish balls. Once they turn a golden brown color, remove them from the oil and place them in a strainer to drain excess oil.

The same procedure was done to the other treatments using separate cooking utensils to eliminate contaminants which will affect the organoleptic characteristics of the product.

Sensory Evaluation

A sensory evaluation was conducted at CEd Cafeteria, Isabela State University Echague Campus to assess the acceptability of Rice Eel *(Monopterus albus)* Fishball fortified with Cassava-based SAGIP Nutri-Powder using a 9-Point Hedonic Scale for appearance, aroma, taste, and overall acceptability.

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The range of scale is interpreted as follows:

Scale	Range	Descriptive Rating
9	8.50- 9.00	Like Extremely
8	7.50- 8.49	Like Very Much
7	6.50- 7.49	Like Moderately
6	5.50- 6.49	Like Slightly
5	4.50-5.49	Neither like or dislike
4	3.50-4.49	Dislike Slightly
3	2.50-3.49	Dislike Moderately
2	1.50-2.49	Dislike Very Much
1	1.00-1.49	Dislike Extremely

A sensory panel was composed of sixty (60) individuals classified into 3 groups: the professionals, students and the tricycle drivers/farmers, encompassing diverse culture in terms of ages among regular street food consumers. This seeks to capture a broad range of preferences and viewpoints regarding street food products. The qualifications of the panelist in terms of age are 18- 50 years old.

Cost and Return Of Investment

Cost analysis was performed to determine the economic feasibility of the product if it will be sold in the market.

This was done by listing down all the costs incurred in producing the different proportions of Rice Eel Fishball Fortified with Cassava- Based SAGIP Nutri- Powder and computing the unit cost and the return on investment (ROI) per treatment.

RESULTS AND DISCUSSION

Summary of Findings

STUDY 1. Determine the level of acceptability of Rice Eel (*Monopterus albus)* Fishball Fortified with Cassava-Based SAGIP Nutri-Powder

In terms of Appearance/color

As shown in Table 1 , the Rice Eel (*Monopterus albus*) Fishball Fortified with Cassava-Based SAGIP Nutri-Powder was well-received across all treatments in terms of appearance/color, aroma/odor, flavor/taste, and general acceptability. Treatment 3 consistently stood out, scoring the highest in appearance (8.38), aroma (8.42), flavor (8.45), and general acceptability (8.35), indicating it was the most preferred among all treatments. Treatment 1 also performed well, receiving scores of 7.75 for appearance, 7.62 for aroma, 7.68 for flavor, and 7.67 for general acceptability, showing it was highly favored by the panelists. Treatment 2, with scores of 7.58 for appearance, 7.58 for aroma, 7.52 for flavor, and 7.68 for general acceptability, was similarly well-received but slightly less than T1. Treatment 4 received the lowest scores in each category 7.30 for appearance, 7.62 for aroma, 7.60 for flavor, and 7.58 for general acceptability, still indicating a strong positive reception. Overall, the high scores across all treatments reflect a strong positive reception, with Treatment 3 emerging as the most preferred in all aspects.

Table 1. Level of acceptability of Rice Eel (*Monopterus albus)* Fishball Fortified with Cassava-Based SAGIP Nutri-Powder

	Appearance/Color	Aroma/Odor	Taste /Flavor	General Acceptability	Mean	Description
Treatment $_1$	7.75 b	7.62	7.68	7.67	7.68	LVM
Treatment $_2$	7.58 bc	7.58	7.52	7.68	7.59	LVM
Treatment $_3$	8.38 a	8.42	8.45	8.35	8.4	LVM
Treatment $_4$	7.30 c	7.62	7.60	7.58	7.52	LVM

Note: LVM- Like Very Much

STUDY 2. Difference in acceptability level of Rice Eel *(Monopterus albus)* Fishball Fortified with Cassava-based SAGIP Nutri-powder.

In terms of Appearance/Color

The analysis of variance for Rice Eel *(Monopterus albus)* Fishballs fortified with Cassava-Based SAGIP Nutri-Powder shows significant differences among treatments. Treatment 3 was most favored with a mean score of 8.38 or Like Very Much, followed by Treatments 1 and 2 with scores of 7.75 and 7.58, respectively. Treatment 4 scored the lowest at 7.30 or Like Moderately. Variability was significant at the 1% level, with a moderate coefficient of variation at 11.77%. Overall, the formulations were well-received, with Treatment 3 being the most appealing.

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Table 2. Appearance/Color of Rice Eel (*Monopterus albus)* Fishball Fortified with Cassava-Based SAGIP Nutri-Powder

TREATMENTS	Mean	Description
Treatment 1	7.75 b	Like Very Much
Treatment 2	7.58 bc	Like Very Much
Treatment 3	8.38 a	Like Very Much
Treatment 4	7.30 c	Like Moderately
ANOVA Result	**	
C.V. (%)	11.77	
LSD	0.43	

Note: Means with the same letter/s are not significantly different from each other using LSD test.
*** - significant at 1% level*

In terms of Aroma/Odor

The analysis of variance for the aroma/odor of Rice Eel *(Monopterus albus)* Fishballs fortified with Cassava-Based SAGIP Nutri-Powder showed significant differences among treatments. Treatment 3 was the most favored with a mean score of 8.42 or Like Very Much. Treatments 1, 2, and 4 also received positive ratings, though slightly lower than Treatment 3. The differences were significant at the 1% level, with a moderate coefficient of variation at 11.54%, indicating consistent responses. Overall, the aroma/odor was well-received, with Treatment 3 being the most appealing.

Table 3. Aroma/Odor of Rice Eel (*Monopterus albus)* Fishball Fortified with Cassava-based SAGIP Nutri-powder.

TREATMENTS	Mean	Description
Treatment 1	7.62 b	Like Very Much
Treatment 2	7.58 b	Like Very Much
Treatment 3	8.42 a	Like Very Much
Treatment 4	7.62 b	Like Very Much
ANOVA Result	**	
C.V. (%)	11.54	
LSD	0.43	

Note: Means with the same letter/s are not significantly different from each other using LSD test.
*** - significant at 1% level*

In terms of Taste/Flavor

The analysis of variance for the taste/flavor of Rice Eel (*Monopterus albus*) Fishballs fortified with Cassava-Based SAGIP Nutri-Powder showed significant differences among treatments. Treatment 3 was the most favored, with the highest mean score of 8.45 or Like Very Much. Treatments 1, 2, and 4 also received positive ratings, with mean values between 7.52 and 7.68. The differences were significant at the 1% level, with a moderate coefficient of variation at 12.05%, indicating consistent responses. The LSD test confirmed that the four treatments were not significantly different in taste/flavor acceptability. Overall, the taste/flavor was well-received, with Treatment 3 being the most preferred.

Table 4. Taste/flavor of Rice Eel (*Monopterus albus)* Fishball Fortified with Cassava-based SAGIP Nutri-powder

TREATMENTS	Mean	Description
Treatment 1	7.68 b	Like Very Much
Treatment 2	7.52 b	Like Very Much
Treatment 3	8.45 a	Like Very Much
Treatment 4	7.60 b	Like Very Much
ANOVA Result	**	
C.V. (%)	12.05	
LSD	0.45	

Note: Means with the same letter/s are not significantly different from each other using LSD test.
*** - significant at 1% level*

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In terms of General Acceptability

The analysis of variance for the general acceptability of Rice Eel (Monopterus albus) Fishballs fortified with Cassava-Based SAGIP Nutri-Powder revealed significant differences among treatments. Treatment 3 was the most preferred, with the highest mean score of 8.35 or Like Very Much. Treatments 1, 2, and 4 also received positive ratings, with mean values between 7.58 and 7.68. The differences were significant at the 1% level, with a moderate coefficient of variation at 12.91%, indicating consistent responses. The LSD test confirmed no significant differences among treatments with the same letter. Overall, Treatment 3 was the most favored for general acceptability.

Table 5. General Acceptability of Rice Eel (*Monopterus albus)* Fishball Fortified with Cassava-Based SAGIP Nutri-Powder

TREATMENTS	Mean	Description
Treatment 1	7.67 b	Like Very Much
Treatment 2	7.68 b	Like Very Much
Treatment 3	8.35 a	Like Very Much
Treatment 4	7.58 b	Like Very Much
ANOVA Result	**	
C.V. (%)	12.91	
LSD	0.48	

Note: Means with the same letter/s are not significantly different from each other using LSD test.
*** - significant at 1% level*

STUDY 3. Most Preferred treatment among the four treatment

Among the four treatments of Rice Eel *(Monopterus albus)* Fishballs fortified with Cassava-Based SAGIP Nutri-Powder, Treatment 3 was the most preferred by panelists. It achieved the highest scores in appearance of 8.38, aroma of 8.42, taste of 8.45, and general acceptability of 8.35, resulting in a top grand mean of 8.4. Treatment 4, although liked very much, had the lowest grand mean of 7.52. Overall, Treatment 3 consistently demonstrated superior sensory attributes and was the most preferred.

Table 6. Most Preferred Treatment among the four treatment of Rice Eel (*Monopterus albus)* Fishball Fortified with Cassava-Based SAGIP Nutri-Powder

TREATMENTS	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Appearance/ color	7.75	7.58	8.38	7.30
Aroma/ odor	7.62	7.58	8.42	7.62
Taste/ flavor	7.68	7.52	8.45	7.60
General Acceptability	7.67	7.68	8.35	7.58
Grand Mean	7.68	7.59	8.4	7.52

STUDY 4. Summary and Computation of Return on Investment of Rice eel (*Monopterus albus)* fishball fortified with Cassava based SAGIP Nutri- Powder

Table 7 summarizes the Cost and Return analysis for making Rice Eel *(Monopterus albus)* Fishballs Fortified with Cassava-Based SAGIP Nutri-Powder across four treatments. Treatments 1, 2, 3, and 4 show varying Return on Investment (ROI) percentages: Treatment 1 (39.80%), Treatment 2 (43.89%), Treatment 3 (42.06%), and Treatment 4 (40.22%). Treatment 2 emerges as the most profitable. Overall, all treatments show positive returns, indicating a viable venture.

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Table 7. Summary and Computation of Return on Investment of Rice Eel (*Monopterus albus)* Fishball Fortified with Cassava-Based SAGIP Nutri-Powder.

TREATMENTS	Treatments			
	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Total Production Cost (Php)	157	262	315	368
Unit Cost = Total Cost / No. Of Packs	39.25	65.5	63	61.33
Selling Price = (Unit Cost x 50% +No. Of Packs)	43.625	36.75	36.5	36.66
Total Sale = Selling Price x No. Of Packs	94.5	147	182.5	219.96
Income = Total Sale- Total Production Cost	62.5	115	132.5	148.04
ROI = Income x100 / Total Production Cost	39.80%	43.89%	42.06 %	40.22%

CONCLUSIONS

Based on the findings of the study, the following conclusions are derived:
First, The Rice Eel *(Monopterus Albus)* Fishball Fortified with Cassava-based SAGIP Nutri-powder regarding from the four different treatments in terms of level of acceptability in different sensory attributes among the four treatments, treatment 3 has gained the highest average mean. Therefore Treatment 3 was the most preferred in four different evaluated sensory attributes. Second, the Rice Eel *(Monopterus Albus)* Fishball fortified with Cassava-based SAGIP Nutri-powder regarding their general acceptability made from the different four treatments have no significant difference. Third, treatment 3 is the most preferred treatment in making Rice Eel *(Monopterus Albus)* Fishball Fortified with Cassava-based SAGIP Nutri-powder gaining a score of 8.4%. Finally, treatment 2 got the highest return on investment of 43.89%, while treatment 3 and treatment 4, has ROI of 42.06% and 40.22%, and lastly treatment 1 has an ROI of 39.80% respectively.

RECOMMENDATIONS

Based on the study results, here are concise recommendations:

1. Study and refine Treatment 3 composition for targeted market segmentation. Educate consumers on its nutritional benefits and continuously enhance the product through feedback and research.
2. Highlight nutritional advantages of rice eel flesh, utilizing all edible parts. Implement quality controls for consistent nutritional content.
3. Allocate resources strategically based on ROI variations to enhance profitability. Emphasize these benefits in marketing and promotions to leverage unique selling points.
4. Perform a thorough nutritional analysis of the rice eel fish ball product to guide further research and development.
5. Investigate product shelf life under various conditions to ensure stability and longevity.
6. Conduct additional research for conclusive and reliable results, exploring various aspects of product development and consumer preferences.

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The Researchers.

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