Innovations

Upscale Production and Commercialization of Daerrys Tilapia Ice Cream and Tilapia Cookies

Dana G. Vera Cruz[1], Tereso A. Abella[2], Venus Q. Lagmay[4], Celyrah B Castillo[1], Pablo J. Rafael[3], Ervee P. Landingin[1], Pamela Denise V. De Ramos[1],Remarjay V. Neypes[1]

Corresponding Author: **Dana G. Vera Cruz**

Abstract: *The successful development of Daerrys Tilapia Ice Cream and Tilapia Cookies contributes significantly to promoting and adopting new and improved technologies for sustainable management and resources in the agricultural sector. Thus, the study aimed at the technology transfer, commercialization, and upscale production of Daerrys products. Partnership and collaboration with the MAnggagawang BUkid Ng Guimba Agriculture (MABUNGA) Cooperative were established for the technology commercialization. The members were trained and capacitated with skills and knowledge in producing the tilapia fillets. As a result, the spin-off company Vera Bella Enterprises Limited Company, created to commercialize the Daerrys products, secured a Food and Drug Administration (FDA) License to Operate (LTO) in March 2022. After the issuance of LTO, production increased by 430% in 2022. In addition, nutritional analyses showed that the products contain more protein than commercially available ice cream products. Moreover, the microbial assessment of the products falls under the acceptable limit based on the FDA standard. As the Daerrys products reached the Technology Readiness Level (TRL) 9 and Marketing Readiness Level (MRL) 8-Proof of Scalability, the products were distributed locally. The products participated in various international exhibits, receiving multiple awards for their innovation and impact on the community.*

Keywords: *technology commercialization, ice cream, tilapia, cookies*

Introduction

Malnutrition and food-related diseases are the pressing problems experienced globally, specifically in insufficient nutrient intake and undernourishment (Tacon & Metian, 2013). Furthermore, in the Philippines, 95 children die from malnutrition every day, while others are stunted or short for their age, where some stunting can be permanent and fatal (Bucu et al., 2016;

Coram International, 2018). Contributing to the increasing malnutrition and undernourishment case is the declining seafood consumption of children, according to McManus et al. (2007).

Addressing the case of malnutrition and undernourishment, McManus et al. (2007) sought to promote seafood, mainly fish, as a vital part of a healthy diet. Moreover, Tacon and Metian (2013) discussed that aquatic foods represent an integral part of the global food supply to improve the nutrition, healthy, and well-being of all people.

In response, Central Luzon State University (CLSU) incorporated fish into desserts children loves, like ice cream and cookies. Elevating nutrition using desserts was made possible through the developed technology of eliminating the fishy flavor of tilapia. The development of local resources is essential to national progress. As the Philippines contributes to regional development, essential products are harnessed toward their full potential to work. CLSU, where tilapia and carabao milk is being produced, gave birth to the Daerrys Tilapia Ice Cream and Tilapia Cookies.

The refined Daerrys products have higher protein content than other commercially available ice creams and cookies. With the new process technology translated into product innovation, the Daerrys Tilapia Ice Cream won the prestigious SIAL Gold Award in 2016, besting 350 exhibitors from 25 countries, and had the chance to tour worldwide in all SIAL Exhibitions as world champion.

In 2018, the technology obtained a utility model from the Intellectual Property Office of the Philippines. Tilapia ice cream was a novel product of R&D that has captured the interest of entrepreneurs and consumers. As a result, it paved the way for upscale production and commercialization of the various Daerrys products through business development. Furthermore, in 2020 the Spin-off company, named "Vera Bella Enterprises Limited Co." was established and obtained a License to Operate (LTO) from the Food and Drug Administration (FDA). This paper highlights the success of tilapia ice cream, a product of R&D, as an enterprise.

Objectives

The main objective of this project was to upscale the production and commercialize the Daerrys Tilapia Ice Cream and Tilapia Cookies.

Specifically, it aimed to:

1. capacitate fish farmers, as part of the supply chain, with the technology and tilapia processing through trainings and workshops;
2. accomplish FDA requirements and legal documents necessary for commercialization; and
3. increase production of Daerrys products and market distribution.

Conceptual Framework

The project had three core components to address and accomplish the expected outputs, Figure 1. The Memorandum of Agreement (MOA) signing with the target cooperative (MABUNGA Coop) and becoming an incubatee of the Central Luzon State University Technology Business Incubator (CLSU TBI) were the key concepts in accomplishing the collaboration with MABUNGA Coop. Furthermore, to capacitate the members of the MABUNGA Coop, training on tilapia growth out, management, and processing; Good Manufacturing Practices (GMP) and food safety; and production of Daerrys Tilapia Ice Cream and Cookies were included. To address the commercialization of the Daerrys products, upscale production was a critical variable. An application for Food and Drug Administration License to Operate (FDA LTO) was filed for product manufacturing, distribution, and marketing.

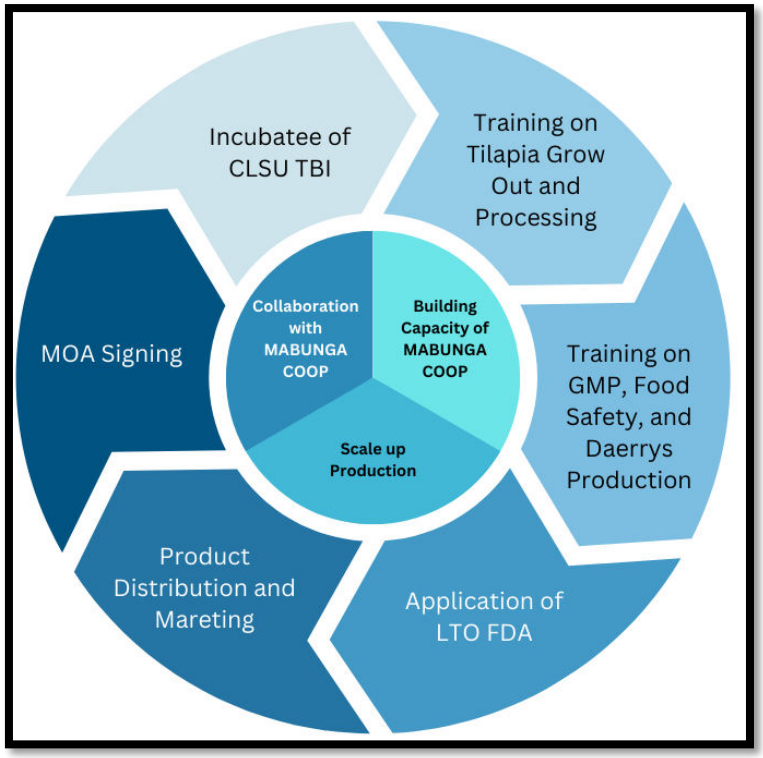


Figure 1. Conceptual framework of the project

Results & Discussion

The MABUNGA Cooperative

The MAnggagawang BUkid Ng Guimba Agriculture (MABUNGA) Cooperative, located at Purok 4, Barangay Caballero, Guimba, Nueva Ecija, is composed of farmers and farm workers who lost their jobs caused of agricultural machinery. The cooperative started with 78 members, 28 of whom are mushroom growers, while the rest are members of micro, small & medium enterprises (MSMEs) that utilize the harvested mushrooms. However, with the source of income focused on mushrooms, the cooperative was greatly affected by the

increased mushroom-growing business around the area, causing slow operations and a decline in sales. As a result, some members departed from the cooperative and focused on their businesses.

Part of the distribution channel of one of the members who produced mushroom chips is the University Multi-Purpose Center for Agriculture Research and Technology Products (UMART) in Central Luzon State University, where they learned of the Tilapia ice cream. As the cooperative expressed their interest in diversifying and engaging in tilapia grow out, the project accepted the cooperative as a project beneficiary and part of the supply chain of the production of the Daerrys Tilapia Ice Cream and Tilapia Cookies.

A partnership between Central Luzon State University and MABUNGA Cooperative was formalized by signing a Memorandum of Agreement (MOA) on December 14, 2020. The collaboration was made to ensure the continuous production and sustainability of raw materials for the upscale production and commercialization of the Daerrys Tilapia Ice Cream and Tilapia Cookies. Ten (10) cooperative members actively participated in the seminars and training on tilapia growth out and processing to diversify and increase their income and revenue.

Through the signing of the MOA, the involvement of the MABUNGA Coop members in the project as its beneficiary and in the supply chain of Daerrys products was specified. The responsibilities of the members included the provision of tilapia fillet, the primary ingredient of the Daerrys products. In addition, the coop members were also briefed on the operation and management of the Daerrys fishpond, and the income and other financial transactions involved in the project.

Moreover, to fully maximize the assistance of the university to the project beneficiary, another MOA was signed between the MABUNGA Coop and the CLSU Technology Business Incubator (CLSU TBI) in January 2021.

Building Capacity of the MABUNGA Cooperative Members

A series of seminars and training workshops were conducted to ensure that the project beneficiary is equipped with the theories and skills needed in the up-scale production and commercialization of Daerrys Tilapia Ice Cream and Tilapia Cookies, Table 1.

On the first and second training, the MABUNGA Coop members were briefed on the history, background, and production of cultured tilapia and were exposed to and toured the Freshwater Aquaculture Center (FAC) facility. After the briefing and tour, the members conducted fishpond activities like pond preparation, stocking, and management. To thoroughly train the coop members on the culture and management of tilapia, and due to the travel restrictions during COVID-19, the available fishpond at the FAC was utilized until the end of the project. Therefore, the coop members coordinated closely with the FAC staff

concerning the fishpond management, where the demand analysis of tilapia for the Daerrys production was presented to the coop members, including the amount of tilapia fillet to produce.

The MABUNGA members were then trained on food safety, Good Manufacturing Practices (GMP), 5S, and the primary operational and environmental conditions required to produce safe food products, particularly the Daerrys products. The members also conducted workshops, evaluating various food preparation areas near the venue, where all the ingredients, products, and packaging materials were ensured to be handled safely and processed in a suitable environment.

Briefed with the knowledge on the biology, operations, and management of tilapia, as well as the GMP and food safety, the coop members were trained on the tilapia processing, specifically tilapia filleting as per the techniques and technology used in the preparation of tilapia for the Daerrys production, Table1 – Training 4. After the tilapia filleting, the members were also taught the operation of the vacuum sealer for the proper packaging of the tilapia fillets. Vacuum packing is a method of preservation where the development of oxidized flavors can be significantly suppressed through 24 weeks of storage (Kumar & Ganguly, 2014). Consequently, vacuum packing is used in storing tilapia fillets for longer shelf-life and quality preservation for Daerrys production.

Table 1. Trainings conducted to capacitate MABUNGA Coop members

TRAINING	**TOPIC**
1	Biology and Culture of Tilapia
2	Tilapia Grow Out Operations and Management
3	Food Safety and Good Manufacturing Practices (GMP) and 5S
4	Tilapia Filleting and Vacuum Packing
5	Tilapia Processing, Fillet Roasting, and Vacuum Packing
6	Products Packaging and Labeling
7	Business Plan Training and Workshop

Subsequently, the coop members were trained on how to flake the tilapia fillets, the roasting process, and the roasted flakes' vacuum packing. The Daerrys Praline Crunch, Fryewich, and Tilapia Cookies used roasted tilapia flakes. The

transfer of the roasting technology to the coop members makes the technology more sustainable. Value chain innovations enhance coop members' adoption of new technologies and can significantly impact modern technology adoption by both the university and the coop members (Swinnen & Kujipers, 2019).

Training 6 focused on a product's standard packaging and labeling, as it is an essential part of the production, providing accurate information about ingredients and other characteristics. Furthermore, the coop members were trained on properly labeling the tilapia fillet products. As a result, a proper label was developed for the tilapia fillet finished products through coordination with the project team.

For the sustainability of the MABUNGA coop members, training on business planning was conducted. The members developed a full-blown business plan and discussed the cooperative's business model canvas (BMC) as part of the workshop. It is a business tool to visualize all the building blocks when starting a business, including customers, route to market, value proposition, and finance (Nikolou, 2020).

Questionnaires were given to the MABUNGA coop members before and after the conducted seminars and training to assess and evaluate the members' performance and acquired knowledge and skills. Shown in Table 2 is the result of the assessment. The post-test ranged from 79.48% to 88.89%, considering the pre-test scores ranged from 35.90% to 75.00%. Based on the pre-test results, the coop members have considerable poor knowledge and skills on the biology and culture of tilapia (Training 1), tilapia grow-our operations and management (Training 2), and tilapia filleting and vacuum packing (Training 4), with scores lower than 50%. However, the post-test showed improved knowledge and skills after the training.

Table 2. Training assessment of MABUNGA Coop members

Training	**MABUNGA Cooperative Members (n)**	**Pre-test Scores (%)**	**Post-test Scores (%)**	**Increase (%)**
1&2	8	35.90	79.48	121.41
3	9	55.55	88.89	60.01
4	9	46.67	83.33	78.57
5	9	53.33	86.67	62.50
7	8	75.00	81.67	8.89

Based on the percent increase results, the highest was obtained on the assessment of training 1 and 2, with 121.41%. At the same time, the lowest is on training 7, with 8.89%. As the members are part of a cooperative, the business plan training and workshop gathered the highest scores among the topics, based on the pre-test score of 75.00%.

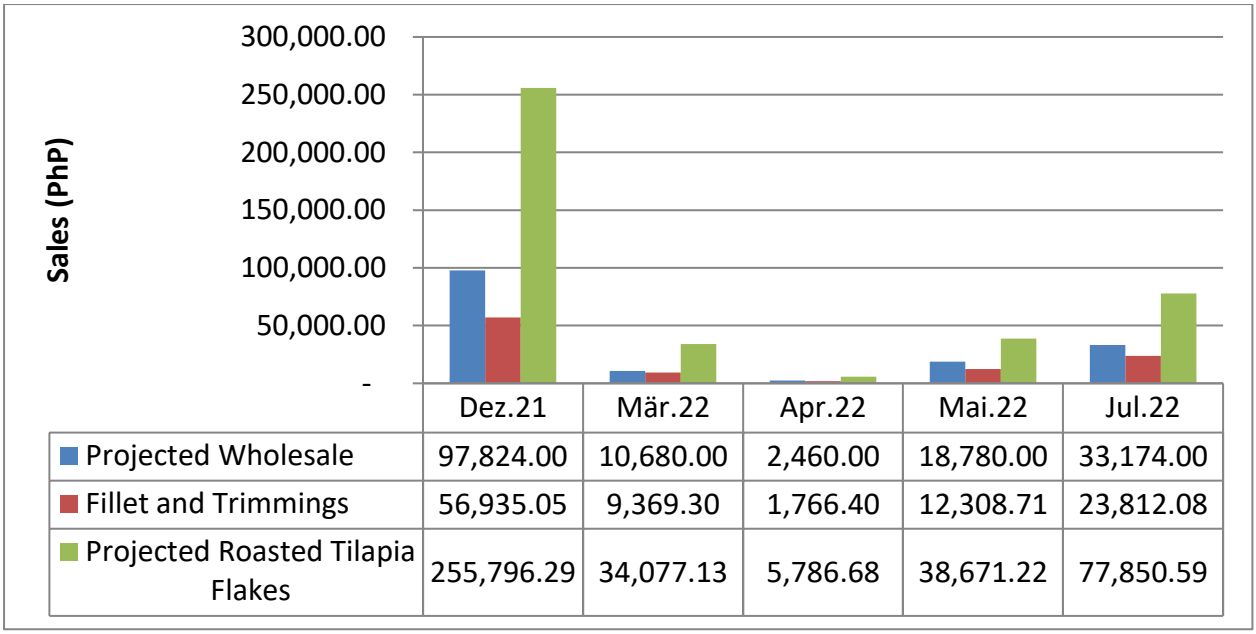
Financial Benefits on MABUNGA Cooperative

The technology transfer to the MABUNGA cooperative members has a significant impact, specifically on the financial conditions of the cooperative itself. The spin-off company bought the tilapia fillet produced by the cooperative at PhP 180.00 per kilogram to utilize in producing Daerrys Tilapia Ice Cream and Tilapia Cookies. The remaining trimmings like the head (PhP 65.00 per kg), belly (PhP 75.00 per kg), skin (PhP 50.00 per kg), and bones (PhP 50.00 per kg) were sold to the markets and were used either as a meal or a fish feeds. As shown in Table 3, the tilapia fillet and trimmings gathered Php 104,191.54 from 1,357.65 kg of tilapia throughout the processing for seven months from December 2021 to July 2022. Most of the sales (68.66%) came from the fillet sales, amounting to PhP 71,542.80, while the least came from the skin sales (PhP 1,422.00), comprising 1.36% of the total sales.

Table 3. MABUNGA sales

Processing Date	**Fillet (PhP)**	**Heads (PhP)**	**Belly (PhP)**	**Skin (PhP)**	**Bones (PhP)**	**Total (PhP)**
Dec-2021	44,398.80	3,688.75	5,400.00	310.00	3,137.50	56,935.05
Mar-2022	5,914.80	1,742.00	907.50	210.00	595.00	9,369.30
Apr-2022	1,004.40	409.50	172.50	37.50	142.50	1,766.40
May-2022	6,712.20	2,835.63	1,345.13	294.25	1,121.50	12,308.71
Jul-2022	13,512.60	5,275.73	2,653.50	570.25	1,800.00	23,812.08
Total	71,542.80	13,951.61	10,478.63	1,422.00	6,796.50	**104,191.54**

However, aside from the fillet processing of tilapia, the introduced technology of tilapia flakes roasting can obtain higher projected gross sales compared to the projected sales when marketed wholesale and the actual gross sales of the fillet and trimmings, Figure 2. Steamed tilapia fillet has a 58% recovery from the fresh tilapia fillet. Subsequently, thirty percent (30%) of the recovered steamed tilapia fillet is the percent yield of roasted tilapia flakes. Following this projection and based on the financial cost of roasted tilapia flakes (Php 5,960.00 per kg), the projected gross total sales amounted to PHP 412,818.92 from 1,357.65 kg of fresh tilapia. Based on the figure below, as the demand for Daerrys products increases, the added income to the trained MABUNGA Coop members also increases.



	Dez.21	Mär.22	Apr.22	Mai.22	Jul.22
Projected Wholesale	97,824.00	10,680.00	2,460.00	18,780.00	33,174.00
Fillet and Trimmings	56,935.05	9,369.30	1,766.40	12,308.71	23,812.08
Projected Roasted Tilapia Flakes	255,796.29	34,077.13	5,786.68	38,671.22	77,850.59

Figure 2. Comparison of MABUNGA Cooperative sales based on projected wholesale, actual fillet and trimmings, and projected roasted tilapia flakes sales

From the fillet and trimmings sales, PhP 21,500.98 (20.64%) was used for travel and operating expenses of the cooperative; PhP 35,038.37 (33.63%) was distributed among the actively involved members on the project; and PhP 47,652.19 (45.74%) was re-invested on equipment and sustainability of the cooperative members. After the engagement with the project, the monthly income increased by PhP 5,005.48 over the two cycles of tilapia grow-out and production.

Upscale Production and Commercialization of Daerrys Tilapia Ice Cream and Tilapia Cookies

The technology of eliminating the fishy aftertaste and smell of tilapia fish and processing it into Daerrys Tilapia Ice Cream and Tilapia Cookies was proven well received by the public. As a result, it has gained popularity as it won the prestigious SIAL Gold Award in 2016 in food innovation, besting 350 exhibitors from 25 countries. Thus, upscale production and commercialization became necessary to address the increasing demand for Daerrys products. Therefore, the following were conducted: business development; FDA LTO application; product label development; upscale production; and market distribution and promotion.

Business Development

A spin-off company (Vera Bella Enterprises Limited Company) was created to commercialize the Daerrys Tilapia Ice Cream and Tilapia Cookies, as per RA 10055 – "Philippine Technology Transfer Act of 2009", Article VI – Commercialization by the Researcher and Establishment of Spin-Off Firms." Vera

Bella Enterprises Limited Company (VBELC) was registered with Security Exchange Commission on October 1, 2020, following legal business requirements.

VBELC had a Technology Licensing Agreement with CLSU for the technology transfer and became an incubatee of CLSU AFTBI as part of the legal requirement in the technology transfer, where the company received technical advice and assistance. Accordingly, VBELC was given a processing area at the CLSU AFTBI building and was renovated through a bank loan from the Land Bank of the Philippines. Subsequently, DOST-PCAARRD provided CLSU with a Fairness Opinion Report (FOR) on December 2021. The FOR assesses whether a proposed technology transfer agreement between a Research and Development Institute (RDI) and a technology adopter or business is fair to the government (DOST-PCARRD, 2020).

FDA LTO Application

License to Operate must be applied at the FDA portal to allow the commercialization of Daerrys Tilapia Ice Cream and Tilapia Cookies. Thus, after the creation of VBELC, the company submitted documents to FDA covering six areas: personnel; equipment; sanitary facilities; production and process control; warehousing and distribution; and other supporting documents. After a thorough evaluation from FDA, VBELC obtained the LTO from FDA in March 2022, Figure 3.

Republic of the Philippines
Department of Health
FOOD AND DRUG ADMINISTRATION
Civic Drive, Filinvest Corporate City, Alabang, Muntinlupa City

FDA

LICENSE TO OPERATE

as

Food Manufacturer

is hereby granted to

Vera Bella Enterprises Limited Co.

AFTBI Building, University Avenue, Central Luzon State University Bantug, Bantug, Munoz, Nueva Ecija

Owner:	**Vera Bella Enterprises Limited Co.**
License Number:	**LTO-3000008935501**
Application Type:	**Initial**
Validity of License:	**21 March 2024**

This LTO shall be renewed within **90 days** before its expiration, upon compliance with relevant laws, rules and regulations and the payment of fees. This LTO may be suspended, cancelled or revoked by this Office for cause if found violating RA 9711 and related issuances.

Furthermore, with this LTO, the FDA allows the establishment to apply for a market authorization [i.e. registration (CPR) or notification] for health products prior to manufacture, importation, sale or offer for sale, distribution, transfer, advertisement and/or promotion as the case may be.

BY AUTHORITY OF THE DIRECTOR GENERAL

PILAR MARILYN M. PAGAYUNAN
Director IV
Center for Food Regulation and Research

DISPLAY IN PUBLIC VIEW

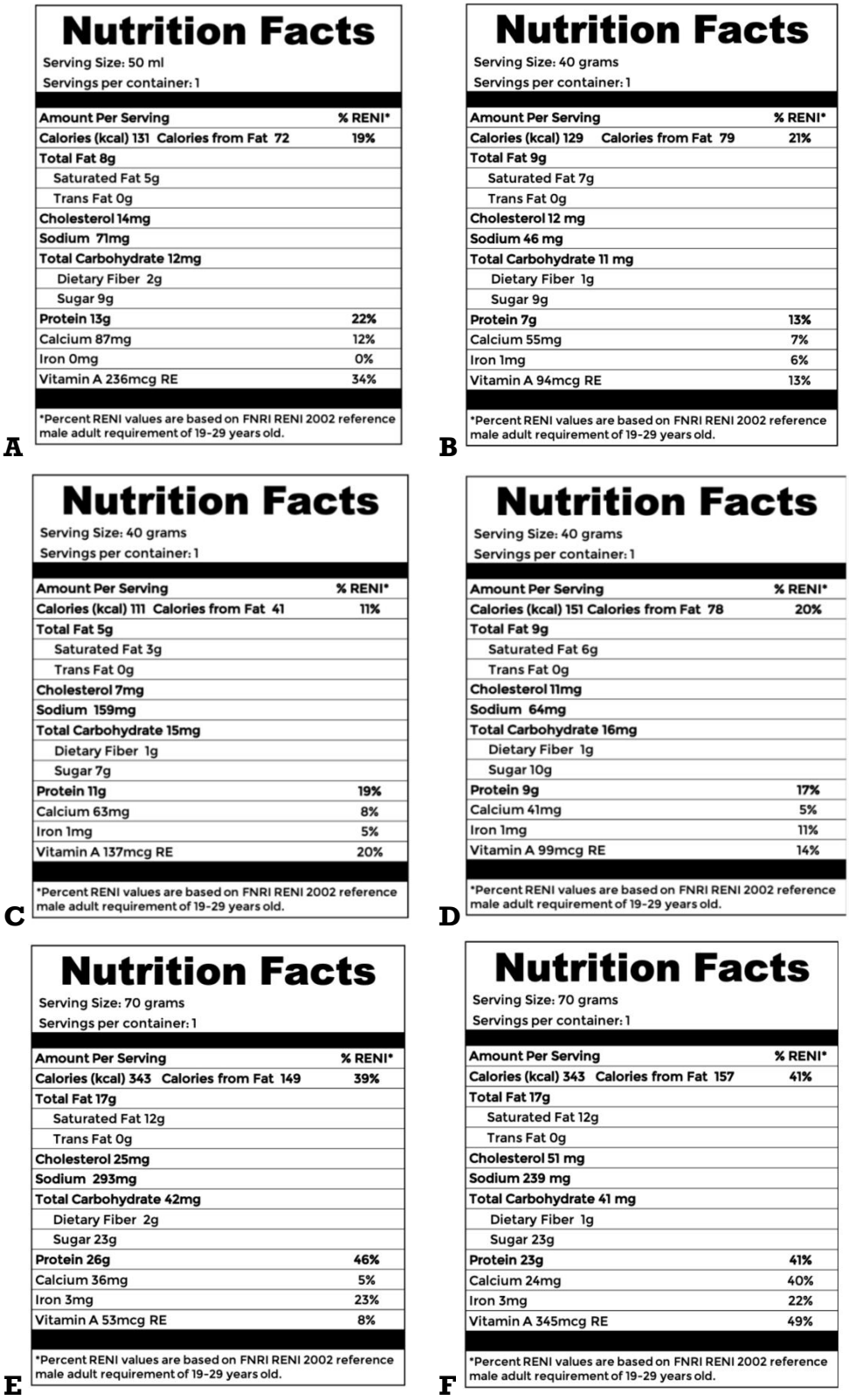
Additional information required under FDA Circular 2016-006 are reflected at the second page of this LTO

This electronic-LTO (eLTO) is computer generated and does not require signature.
Verify at http://www.fda.gov.ph/industry-corner/e-lto/-LTO-3000008935501

FDA-0308961

Figure 3. FDA LTO permit to VBELC.

Upon obtaining FDA LTO for VBELC, the Daerrys products can be distributed nationwide through Certification of Product Registration (CPR) to get a barcode, a requirement of local supermarkets. Therefore, nutritional analysis and microbial analysis of each product were conducted. As a result, the Daerrys products recently received an international barcode from GS1 barcodes that can be accepted by major retailers and distributors worldwide.



A

Nutrition Facts

Serving Size: 50 ml
Servings per container: 1

Amount Per Serving	% RENI*
Calories (kcal) 131 Calories from Fat 72	19%
Total Fat 8g	
Saturated Fat 5g	
Trans Fat 0g	
Cholesterol 14mg	
Sodium 71mg	
Total Carbohydrate 12mg	
Dietary Fiber 2g	
Sugar 9g	
Protein 13g	22%
Calcium 87mg	12%
Iron 0mg	0%
Vitamin A 236mcg RE	34%

*Percent RENI values are based on FNRI RENI 2002 reference male adult requirement of 19-29 years old.

B

Nutrition Facts

Serving Size: 40 grams
Servings per container: 1

Amount Per Serving	% RENI*
Calories (kcal) 129 Calories from Fat 79	21%
Total Fat 9g	
Saturated Fat 7g	
Trans Fat 0g	
Cholesterol 12 mg	
Sodium 46 mg	
Total Carbohydrate 11 mg	
Dietary Fiber 1g	
Sugar 9g	
Protein 7g	13%
Calcium 55mg	7%
Iron 1mg	6%
Vitamin A 94mcg RE	13%

*Percent RENI values are based on FNRI RENI 2002 reference male adult requirement of 19-29 years old.

C

Nutrition Facts

Serving Size: 40 grams
Servings per container: 1

Amount Per Serving	% RENI*
Calories (kcal) 111 Calories from Fat 41	11%
Total Fat 5g	
Saturated Fat 3g	
Trans Fat 0g	
Cholesterol 7mg	
Sodium 159mg	
Total Carbohydrate 15mg	
Dietary Fiber 1g	
Sugar 7g	
Protein 11g	19%
Calcium 63mg	8%
Iron 1mg	5%
Vitamin A 137mcg RE	20%

*Percent RENI values are based on FNRI RENI 2002 reference male adult requirement of 19-29 years old.

D

Nutrition Facts

Serving Size: 40 grams
Servings per container: 1

Amount Per Serving	% RENI*
Calories (kcal) 151 Calories from Fat 78	20%
Total Fat 9g	
Saturated Fat 6g	
Trans Fat 0g	
Cholesterol 11mg	
Sodium 64mg	
Total Carbohydrate 16mg	
Dietary Fiber 1g	
Sugar 10g	
Protein 9g	17%
Calcium 41mg	5%
Iron 1mg	11%
Vitamin A 99mcg RE	14%

*Percent RENI values are based on FNRI RENI 2002 reference male adult requirement of 19-29 years old.

E

Nutrition Facts

Serving Size: 70 grams
Servings per container: 1

Amount Per Serving	% RENI*
Calories (kcal) 343 Calories from Fat 149	39%
Total Fat 17g	
Saturated Fat 12g	
Trans Fat 0g	
Cholesterol 25mg	
Sodium 293mg	
Total Carbohydrate 42mg	
Dietary Fiber 2g	
Sugar 23g	
Protein 26g	46%
Calcium 36mg	5%
Iron 3mg	23%
Vitamin A 53mcg RE	8%

*Percent RENI values are based on FNRI RENI 2002 reference male adult requirement of 19-29 years old.

F

Nutrition Facts

Serving Size: 70 grams
Servings per container: 1

Amount Per Serving	% RENI*
Calories (kcal) 343 Calories from Fat 157	41%
Total Fat 17g	
Saturated Fat 12g	
Trans Fat 0g	
Cholesterol 51 mg	
Sodium 239 mg	
Total Carbohydrate 41 mg	
Dietary Fiber 1g	
Sugar 23g	
Protein 23g	41%
Calcium 24mg	40%
Iron 3mg	22%
Vitamin A 345mcg RE	49%

*Percent RENI values are based on FNRI RENI 2002 reference male adult requirement of 19-29 years old.

Figure 4. Nutrition facts of the Daerrys products: A – Classic cup; B – Praline Crunch; C – Sandwich; D – Fryewich; E – Plain Cookies; and F – Choco-dipped Cookies

Results revealed significant findings in terms of the protein content of the

products. As shown in Figure 4, the products contained 13g of protein per 50 mL serving of the classic ice cream cups. It also has 7g of protein per 40g serving of the praline crunch, 11g of protein per 40g serving of the ice cream sandwich, 9g protein per 40g serving of the Fryewich, 26g protein per 70g serving of the plain cookies, and 23g protein per 70g serving of the choco-dipped cookies. According to the nutrition facts shown in the figure above, Daerrys Tilapia Ice Cream provides 13% to 22% of the daily recommended protein intake, based on the FNRI RENI 2002 reference for a male adult of 19-29 years old. Subsequently, the Daerrys Tilapia Cookies provide 41% to 46% of the daily recommended protein intake.

Microbial assessments of the Daerrys products were determined to evaluate the microorganisms present. The microbial count, and acceptable limits for the Daerrys Tilapia Ice Cream and Tilapia Cookies, were based on the FDA Circular No. 2013-010 (2013) under the category of edible ices, including sherbet and sorbet, specifically, ice cream with added ingredients (nuts, fruits, cocoa, etc.); and bakery products, specifically, baked goods (microbiologically sensitive types, e.g., containing eggs & dairy products), respectively. Regarding the microbial assay (total plate count, coliform count, Staphylococcus aureus count, and presence of Listeria monocytogenes), the microbial counts of Daerrys products fall within the acceptable and tolerable limit, as per FDA standards.

Table 4. Microbial assessment of the Daerrys products

Daerrys Tilapia Products	**Total Plate Count (CFU/g)**	**Coliform (MPN/g)**	***Staphylococcus aureus* (CFU/g)**	***Listeria monocytogenes* (in 25g)**
Ice cream classic cup	8,100	220	<10	Absent
Ice cream Praline Crunch	240	40	<10	Absent
Ice cream Sandwich	4,500	40	<10	Absent
Ice cream Fryewich	640	13	<10	Absent
Plain Cookies	20	<1.8	<10	Absent
Choco-dipped Cookies	70	<1.8	<10	Absent

Product Label Development

The Daerrys Tilapia Ice Cream and Tilapia Cookies underwent a focus group discussion (FGD) to enhance the branding, packaging, and label design on October 8, 2020. Consisting of ten panels, the FGD went on where the panels identified the significant parts in the label, including the font size of the display information and the actual photo of the products. A panel suggested using blue (for aquaculture) and white (for milk from Buffalo), a branding color since it is rarely seen in the ice cream product line. Product evaluation and assessment concerning product variety, quality, design, features, brand name, packaging,

sizes, and price were also discussed during the FGD sessions. As a result, the panels decided to use an aqua blue, along with the designs, as shown in Figure 5.

Figure 5. The official packaging and label of Daerrys products

Upscale Production

The Daerrys Tilapia Ice Cream and Tilapia Cookies started as an Income Generating Project (IGP) of the university in 2018, where 8,282 pcs of ice cream were produced, Figure 6. In 2019 and 2020, Daerrys production increased by 19% and 7%, respectively. A decline of 60% in the production of Daerrys products can be attributed to the pandemic situation and the pending FDA application, with 4,226 pcs produced. However, due to marketing and promotions and obtaining an FDA LTO permit, the production increased by 430% in 2022, with 22,380 pcs produced.

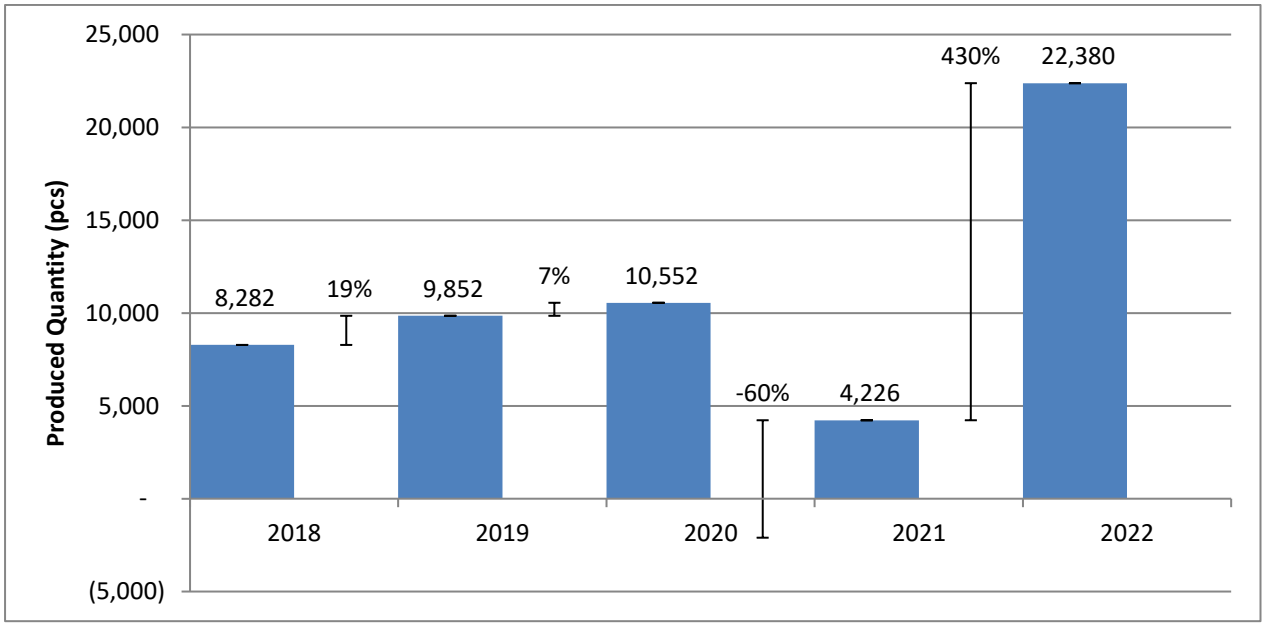


Figure 6. Daerrys production analysis from 2018 to 2022

Consequently, the increase in the production of Daerrys products indicates an increase in the company's gross sales, Figure 7. However, the gross sales of Daerrys products (Figure 7) are not congruent with Daerrys production (Figure 6) since most of the produced ice cream and cookies in 2020 were explicitly allotted for the research and development of the products. The R&D of the products included the nutritional analysis (Figure 4) and microbial analysis (Table 4) of the products. This explains the production increase in 2020 from Figure 6 and the decrease in sales in the same year, as shown in Figure 7.

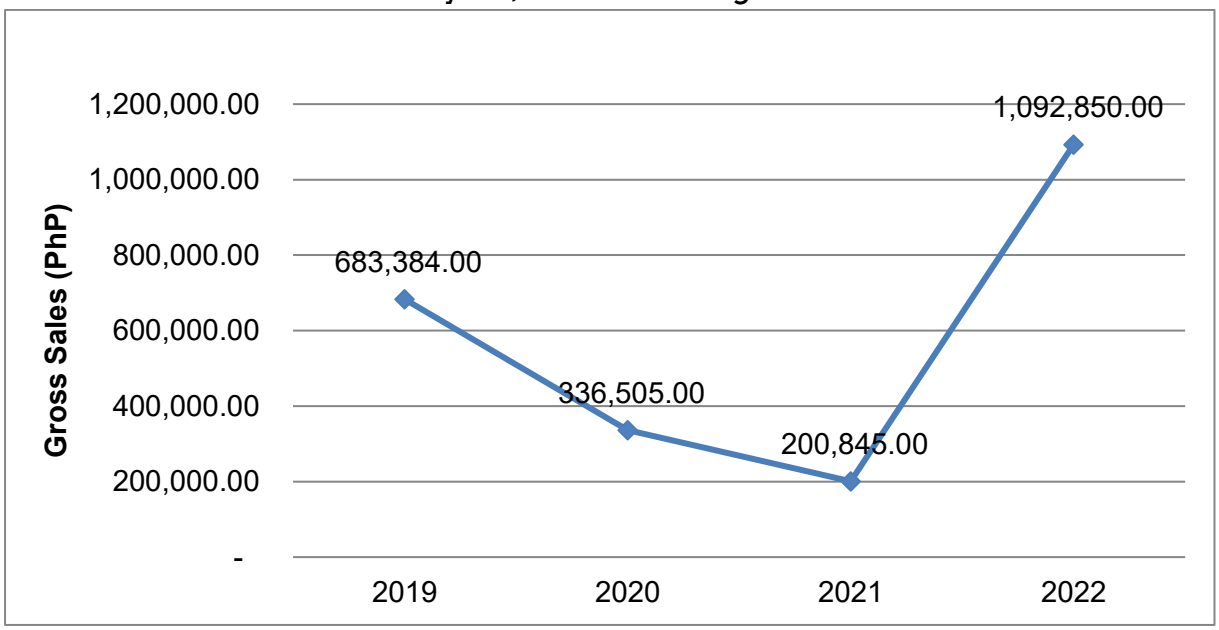


Figure 7. Daerrys gross sales from 2019 to 2022

The detailed gross sales for the project duration (2020 to 2022) are shown in Figure 8. The gap in sales from June 2021 to December 2021 can be attributed to the pending FDA LTO permit application and pandemic, which includes travel restrictions, a series of lockdowns in the university and nationwide, and availability issues of raw materials. However, as the economy slowly opened and with the FDA-LTO permit, an increase in sales was evident, with the highest sales in March 2022, amounting to PhP164,800.00. The sudden increase in sales in March 2022 is a product of the collaboration with the university, as the Daerrys products were used as tokens to visitors and events. As the distribution of the Daerrys products depended significantly on the university's events, the sales fluctuated from January to April 2022. The gradual increase in sales from April 2022 to June 2022 can be attributed to the growing distribution channel of the products, including trade fairs, resellers, and distributors.

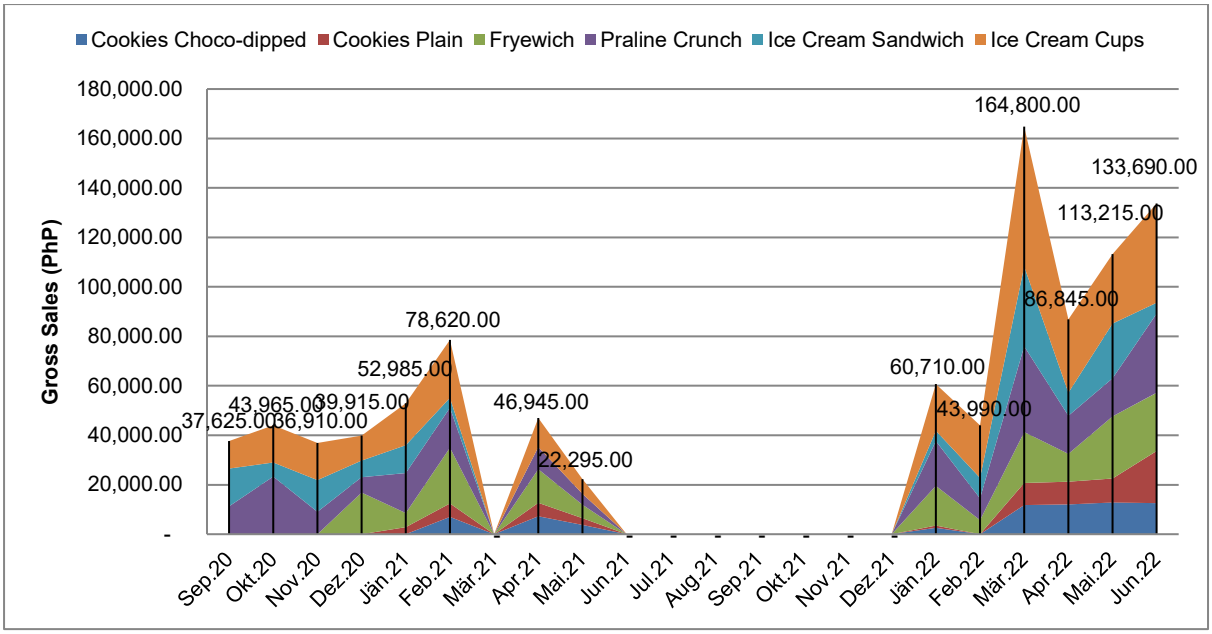


Figure 8. Daerrys Tilapia Ice Cream gross sales from September 2022 to June 2022

Market Distribution and Promotion

Market distribution and promotion are vital in commercializing Daerrys products after the business development, securing the FDA LTO permit, developing the product label, and upscale production. Therefore, local distribution was made possible, along with partnerships, both locally and internationally.

VBELC utilizes social media platforms like Facebook, email, and other application. The partnership with other agencies also became part of software applications available in the play store. IEC materials were also developed for dissemination to walk-in customers, tradeshows, and exhibits. The office of Vera Bella and the 50 sq meters processing area at the AFTBI were showcased for all the visitors who benchmark technology transfer and businessdevelopment.

Local Distribution

Through the promotion of the Daerrys products, cafes, hotels, and techno-demo stores showed interest and became distributors of the products after meetings, ocular inspection, and orientation. Currently, the Daerrys products are distributed in Nueva Ecija, specifically at: Harvest Hotel, Cabanatuan City; Lumings Café, San Jose City; Milka Krem, Science City of Muñoz; Kafe Klasiko, Cabanatuan City; and PCC at CLSU.

The VBELC is also partnered with the Department of Trade and Industry (DTI). They were included in all DTI activities like exhibits, tradeshows, training, and workshops. Radio and Television programs also featured Daerrys Tilapia Ice Cream and Tilapia Cookies for free from 2012 to now.

International Partnerships and Exhibits

The marketing and promotion of Daerrys Tilapia Ice Cream and Tilapia Cookies also paved the way for a Joint Venture Agreement with PWD Smart Farmability, Malaysia, for its global commercialization. Therefore, VBELC signed a Joint Venture Agreement through B2B with the PWD Smart Farmability in Malaysia. This aimed for the global commercialization of Daerrys Tilapia Ice Cream and Tilapia Cookies as part of the World Humanitarian Drive project-Feeding Without Borders. PwD Smart Farmability is a social enterprise with the World's First Regenerative Organic Vegetable Terrarium & World's First Regenerative Soil-Ution Aquaponics Satellite Farm.

The Vera Bella and Daerrys Products were introduced during the PWD Smart Farmability event last April 14, 2021, with the Theme: "Paraplegics Join Forces to Nutritionally Empower People with Disabilities." Furthermore, the Daerrys products reached Malaysia for the Malaysian International Food and Beverage (MIFB) Trade Fair through PWD Smart Farmability on July 5-8, 2022. The products were successfully introduced to all attendees in different parts of the world. Moreover, it gained a positive result with all the comments of those who tried the products.

The Daerrys products were showcased simultaneously at the ASEAN-INDIAN Start-Up Festival in Bogor, Indonesia, and Agri-Food Teach Expo in Singapore in 2022. The crowd clamored for this novelty ice cream.

The Daerrys products were continuously promoted in the pitch at the ASEAN SUMMIT and presented at the DA-BAR-DOST PCAARRD joint Technology Forum in September 2021. In addition, an interview with the World Humanitarian Drive Inspiring Millions Show in London via zoom was also allowed to promote the Daerrys products on May 20, 2022.

Conclusions and Recommendations

The technology and the sustainability of the raw materials are essential in the upscale production and commercialization of Daerrys Tilapia Ice Cream and Tilapia Cookies. Therefore, collaboration with MABUNGA Cooperative, a project beneficiary, was made, where the coop members were trained on tilapia processing and technology. With the increasing demand for Daerrys products, VBELC, a spin-off company to commercialize the products, was created. As the company's License to Operate (LTO) was acquired and the product brand and label were finalized, upscale production was conducted to fully commercialize the Daerrys Tilapia Ice Cream products. Through the increasing market channel and promotion, B2B partnerships were made, like the joint venture agreement between VBELC and PWD Smart Farmability, Malaysia, which will make global commercialization of the products possible. Technology Readiness Level 9 and Marketing Readiness Level 8 were realized through these activities conducted for the last two years.

Based on the results of the commercialization and upscale production of the Daerrys products, the MABUNGA Cooperative will become a part of the supply chain of the Daerrys production for the cooperative's sustainability. In addition, continuous research and development of the products should be conducted, like the shelf-life analysis, to increase the distribution of the products. Furthermore, to make the company more sustainable, continuous partnerships with potential distributors, re-sellers, and investors will be considered.

Author Address:
[1]Department of Hospitality and Tourism Management, College of Home Science and Industry, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines
[2]Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines
[3]Agriculture and Food Technology Business Incubator, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines
[4]Department of Food Science and Technology, College of Home Science and Industry, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines

References

1. *Bucu, A., Calibo, A., Garg, A., Galera, R., Paje, R., & Zeck, W. (2016). Management of severe acute malnutrition in the Philippines. Retrieved January 15, 2023, from www.unicef.org*
2. *Coram International. (2018). Situation analysis of children in the Philippines. Retrieved January 15, 2023 from www.unicef.org*
3. *FAO. (2004), Examen mundial de la pesca y aquacultura: fisheries information sistem. www.fao.org (10 jun. 2004)*
4. *Ferraz de Arruda, L. (2004), Aproveitamento do resíduo do beneficiamento da tilápia do nilo (Oreochromis niloticus) para obtenção de silagem e óleo como subprodutos. Dissertação (Mestrado) Escola Superior De Agricultura "Luiz De Queiroz", Universidade De São Paulo, Piracicaba, Brasil. 78p.*
5. *Fessehaye, Y. (2006). Natural Mating in Nile Tilapia (Oreochromis Niloticus L.): Implications for Reproductive Success, Inbreeding and Cannibalism. Wageningen University and Research.*
6. *FDA Circular No. 2013-010. (2013). Revised Guidelines for the Assessment of Microbiological Quality of Processed Foods.*
7. *Goff, H. D. (2021). Ice Cream Technology eBook, Dairy Education eBook Series. University of Guelph, Canada.*
8. *Josupeit, H. (2010) World Supply and Demand of Tilapia. FAO, Rome.*
9. *Just the facts – ice cream in the Philippines (2023) Just Food. Available at: www.just-food.com*

10. *Kumar, P. U. R. U. S. H. O. T. A. M., & Ganguly, S. U. B. H. A. (2014). Role of vacuum packaging in increasing shelf-life in fish processing technology. Asian Journal of Bio Science, 9(1), 109-112.*
11. *Market Research (2020). The Philippine Ice Cream . www.marketresearch.com*
12. *McManus, A, Burns, S.K., Howat,P,A., Cooper, L, Fielder,L.(2007). Factors Influencing the Consumption of Seafood among Young Children in Perth: A Qualitative Study.BMC Public Health, June 25, 2007*
13. *Mohan, MS et al., 2014. Milk and Ice Cream Processing. In Food Processing: Principles and Applications, Second Edition. John Wiley & Sons, Ltd.*
14. *Nikolou, M. (2020). Business Model Canvas Explaines. Retrieved January 23, 2023 from eship.ox.ac.uk*
15. *Swinnen, J., & Kuijpers, R. (2019). Value chain innovations for technology transfer in developing and emerging economies: Conceptual issues, typology, and policy implications. Food Policy, 83, 298-309.*
16. *Tacon, A. G., & Metian, M. (2013). Fish matters: importance of aquatic foods in human nutrition and global food supply. Reviews in fisheries Science, 21(1), 22-38.*
17. *Trewavas E. Tilapine fish of the genera London. Sarotherodon, Oreochromis and Danakilia. 1983, Cornell University Press, Ithaca, NY.*

Acknowledgement

The study was made possible through the Department of Agriculture-Agricultural Competitiveness Enhancement Fund (DA-ACEF) funding. In addition, the project appreciates the support of the following: DA-BAR, FAC, CLSU AFTBI, DOST-PCAARRD, College of Home Science and Industry, Department of Hospitality and Tourism Management and Department, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, for the assistance and the use of their laboratory and facilities.