MICROBIAL IDENTIFICATION AND ANTIMICROBIAL RESISTANCE OF MICROORGANISMS PRESENT IN LAMP SHELL (*Lingula anatina Lamarck, 1801*) AND PEANUT WORM (*Sipunculus nudus Linnaeus, 1766*) SEAFOOD SAMPLES AT BARRA, TUDELA, MISAMIS OCCIDENTAL

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CERTIFICATE OF PANEL APPROVAL

The research paper attached hereto, entitled "**MICROBIAL IDENTIFICATION AND ANTIMICROBIAL RESISTANCE OF MICROORGANISMS PRESENT IN LAMP SHELL (*Lingula anatina Lamarck, 1801*) AND PEANUT WORM (*Sipunculus nudus Linnaeus, 1766*) SEAFOOD SAMPLES AT BARRA, TUDELA, MISAMIS OCCIDENTAL,**" prepared and submitted by **RHINNA BETH V. ABAO, ZAIRA MICH O. GARCIA, KIRSTEN LEVI V. LABASTILLA, JULIANA VANNICE B. LACUATA, GRACE C. LANAS, EIDNEL JHANE L. LLOBRERA, NICHAELA HONEY S. MOTUS**, in partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN MEDICAL TECHNOLOGY**, is hereby recommended for approval.

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ABSTRACT

Coastal marine ecosystems are increasingly acknowledged as possible sources of antimicrobial-resistant bacteria that could be spread through seafood ingestion. This research analyzed the microbial makeup and antimicrobial resistance (AMR) characteristics of edible seafood obtained from the coastal waters of Barangay Barra, Tudela, Misamis Occidental, utilizing the lamp shell *(Lingula anatina Lamarck, 1801)* and peanut worm *(Sipunculus nudus Linnaeus, 1766)* as biological indicators because of their strong connection to bottom sediments, where pollutants and resistant microorganisms were known to accumulate. Samples were collected under sterile conditions from Barangay Barra, Tudela, and were processed in the Medical Technology Laboratory of Misamis University. Bacterial isolation, identification, and antibiotic susceptibility testing were carried out utilizing the *VITEK* system in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines. A total of 3 bacterial isolates were obtained such as *Vibrio alginolyticus, Vibrio parahaemolyticus, and Klebsiella pneumoniae* ssp *pneumoniae*. Antimicrobial testing showed Ampicillin demonstrated the strongest and most consistent resistance across all bacterial isolates from both peanut worm and lamp shell. In contrast, the highest susceptibility profiles were consistently noted in aminoglycosides (Amikacin and Gentamicin), fluoroquinolones (Ciprofloxacin), and advanced cephalosporins (Cefotaxime, Ceftazidime, and Cefepime), which demonstrated an outstanding susceptibility record across all samples tested. Additionally, Amoxicillin/Clavulanic acid and Piperacillin/Tazobactam remained highly effective, whereas Meropenem and Trimethoprim/Sulfamethoxazole showed reduced efficacy due to emerging resistance in specific samples. These results indicate possible public health hazards linked to eating contaminated seafood and highlight the necessity for ongoing surveillance of microbial contamination and antimicrobial resistance in coastal waters to ensure seafood safety, safeguard public health, and promote sustainable management of coastal resources.

Keywords: *antibiotics, seafood contamination, Vibrio species, Klebsiella pneumoniae, VITEK system*

DEDICATION

This study is lovingly dedicated to everyone who has been part of our journey. We are deeply grateful to those who stood by us through every challenge, sleepless night, and milestone that led to the completion of this study.

Above all, we thank ***God*** *for His constant strength, wisdom, and guidance, which carried us through every obstacle and made this achievement possible.*

To our research advisers, ***Ruthie M. Balasabas, RMT, MBA-HHA,*** *and* ***Darwin R. Taylaran, LPT****, thank you for your patience, guidance, and encouragement. Your support and valuable insights helped us grow not only as researchers but also as individuals.*

To our ***beloved families****, especially our parents, thank you for your endless love, sacrifices, prayers, and unwavering support. Your faith in us gave us the strength to keep going.*

To our friends, classmates, and ***everyone*** *who supported us along the way, thank you for your encouragement, kindness, and companionship. You made this journey more meaningful.*

Lastly, to ***ourselves****— the researchers. This study is a reflection of our perseverance, faith, and the unwavering support of everyone who believed in us. We will always cherish the lessons, memories, and experiences gained throughout this journey.*

The Researchers

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This research is a testament to perseverance, faith, and the collective support of everyone who believed in us. To all who became part of this journey, we offer our sincere gratitude.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

INTRODUCTION

Background of the Study

For generations, the ocean has been more than just a source of food. It has been the foundation of life and livelihood for people living in coastal communities as marine resources are closely linked to people's livelihoods and economy in the Philippines. Seafood had not only been important components of marine biodiversity but were also deeply integrated into local food traditions and economies, reflecting the deep connection between coastal communities and the ocean (Balisco et al., 2022). While these edible marine resources and seafood are valuable to both people and the marine environment, they are also highly vulnerable to pollution and changes in water quality. Living close to or within sediments, these organisms are constantly exposed to microorganisms present in their surroundings. Many of them feed by filtering water or consuming organic matter from the seabed, which makes them more likely to accumulate bacteria (Banda et al., 2023). Studies have shown that invertebrates collected from coastal areas can harbor harmful pathogens such as *Vibrio* species, and other coliform bacteria which pose potential health risks to human health when contaminated seafood is consumed (Fehrenbach et al., 2024).

The coastal-marine environment is prone to faecal contamination from animal waste and human waste introduced through land runoff, sewage discharge, and even human waste disposal from housing communities near the water. According to Kraemer et al.

(2019), fish and shellfish harvested in these contaminated waters are prone to contamination, harbouring enteric pathogens harmful to humans when consumed. According to WHO (2025), coliform bacteria with distinct clonal types have acquired virulence traits that make them highly pathogenic and capable of triggering various intestinal and extraintestinal infections. These infections often lead to sepsis, organ failure, and even death (World Health Organization, 2025). Reportedly, antibiotic-resistance is increasingly being associated in food-associated microbial contamination, with the imprudent use of antibiotics in agriculture and healthcare being key contributors determined in the alarming rise of antibiotic resistance amongst pathogens (Canica et al., 2019). These Gram-negative bacteria found in bloodstream infections have developed multidrug resistance to many commonly used antibiotics, leading to serious public health concerns (World Health Organization, 2025).

Lamp Shell *(Lingula anatina Lamarck, 1801)* is known as a brachiopod species in the genus *Lingula* and like other members of its genus, their species is described as filter feeders as they are described to extract food from water through the use of lophophore (Rakmawati et al. 2025). Peanut Worm *(Sipunculus nudus Linnaeus, 1766)***,** known locally as *Sasing,* are species found mostly in tropical islands like the Philippines. They are described as marine invertebrates characterized by thick and cylindrical bodies and a whitish color upon collection (Tsuhi, 2024). Both species can be found living in vertical burrows in sandy bottoms and muddy substrates and are partially exposed during low tides (Garani et al. 2024). Thus, the method of locating burrows and using tools, such as spatulas, to dig and capture these marine organisms (Tsuhi, 2024) are utilized by harvesters.

One of these pathogenic bacteria that can be found in bacterial isolates is the Gram-

negative bacterium *Klebsiella* spp. This opportunistic pathogen is linked to various infections like urinary, respiratory, and bloodstream infections (Verburg et al. 2024). The *Klebsiella pneumoniae* plays a key role in spreading antibiotic resistant genes between the environmental and clinical settings in healthcare. Their species complexes are widely distributed in the environment, thus they are known inhabitants of water, plants, animals, and humans (Thorpe et al. 2021).

Highly human pathogenic bacteria, such as *Vibrio* spp*.,* are known to naturally inhibit bodies of water and marine environments (Akdemir Evrendilek, 2026). The consumption of water or seafood from these sources can cause severe outbreaks of diseases collectively referred to as vibriosis. According to a study conducted by Destoumieux-Garzón et al. (2020), most Vibrionaceae bacteria, including *Vibrio* spp*.,* demonstrates opportunistic pathogenic behavior, naturally existing as part of normal microflora in aquatic animals. Thus, the association between their natural existence amongst aquatic microflora and their pathogenic behavior enable their persistence and survival within seafood products, wherein their bacterial attachment takes place through direct contact with contaminated water. For the colonization and subsequent transmission of these bacterial pathogens to persist, extensive studies have demonstrated the adhesive and biofilm-forming capabilities of human pathogenic *Vibrio* spp. on biotic surfaces of marine organisms (Akdemir Evrendilek, 2026).

An even greater concern today is the rise of antimicrobial resistance (AMR). Around the world, coastal waters have become reservoirs of bacteria that no longer respond to commonly used antibiotics. This is often linked to the release of wastewater, agricultural runoff, and the misuse of antibiotics in aquaculture systems (Shao et al., 2021). When

benthic invertebrates are exposed to these environments, they can serve as carriers of resistant bacteria, silently passing them along the food chain. In the Philippines, resistant *Vibrio* and coliform bacteria have already been detected in aquacultured seafood, raising alarms about food safety and treatment challenges (Mecha et al., 2020).

Despite these growing concerns, most studies have focused only on commercially known bivalves such as mussels and oysters but not to other benthic invertebrates like lamp shell *(Lingula anatina Lamarck, 1801)*, and peanut worm *(Sipunculus nudus Linnaeus, 1766)*. No investigations have been conducted to assess their microbial safety. Addressing this gap, not only protects the health of consumers but enables a better understanding of the role of benthic invertebrates as possible reservoirs of antimicrobial-resistant bacteria in marine ecosystems.

Misamis University often holds extension programs dedicated to the betterment of the communities. According to Yapac (2024), Barangay Barra, Tudela, a coastal community, has been one of the long-time partners of the Misamis University College of Maritime Education through their Coastal Resources Regeneration and Alternative Livelihood (CoRRAL) Project since 2010. Part of their initiatives to actively support the development of the community were the coastal cleanup and construction of communal toilets. Thus, this study will also be beneficial in determining whether these efforts put towards the restoration and preservation of the surrounding coastal life in Barangay Barra prove to be advantageous to marine life and effective in preventing contamination amongst seafood.

Objectives of the Study

This study aimed to conduct microbial identification and antimicrobial resistance among edible seafood collected from Barangay Barra, Tudela, Misamis Occidental and to assess the results potential effects on food safety and public health. Specifically, this study aimed to:

1. Identify microbial presence in seafood, specifically the lamp shell *(Lingula anatina Lamarck, 1801)* and the peanut worm *(Sipunculus nudus Linnaeus, 1766)* from Tudela, Misamis Occidental;
2. Determine the antimicrobial resistance profiles of the isolated microorganisms; and
3. Assess the possible health risks associated with the consumption of contaminated or antimicrobial-resistant bacteria in seafood.

Significance of the Study

Seafood, particularly lamp shell *(Lingula anatina Lamarck, 1801),* and the peanut worm *(Sipunculus nudus Linnaeus, 1766),* had played an important role in the community of Tudela, Misamis Occidental. This study is valuable because it examined the types of bacteria present in the seafood and their response to commonly used antibiotics. Understanding this information will assess the condition of the coastal waters where the seafood has been collected, informing the community of its possible health risks. The results of this study have increased public awareness regarding the safe consumption of locally harvested seafood and provide scientific data to support local authorities, researchers, and policy makers in establishing newer and more effective policies or

revisiting pre-existing ones. Furthermore, this study will guide and inform the common people regarding food safety, health awareness and environmental protection.

In the healthcare setting, this study enhances laboratory and diagnostic skills in microbial detection and antimicrobial susceptibility testing whilst contributing valuable data on food safety and disease prevention. Additionally, in modern medicine, where antibiotics are becoming less effective, research on AMR in environmental and food sources such as seafood is essential in preserving the effectiveness of current antimicrobial drugs and helping healthcare professionals address the growing global problem of antimicrobial resistance. Overall, it bridges environmental health, food safety, and clinical medicine.

Scope and Delimitations

This study focused on selected seafood species, specifically the lamp shell *(Lingula anatina Lamarck, 1801)* and the peanut worm *(Sipunculus nudus Linnaeus, 1766)*, collected directly from the coastal waters in Tudela, Misamis Occidental. The study employed a quantitative, descriptive cross-sectional research design to determine the presence of bacterial contaminants and assess their antimicrobial susceptibility profiles. The investigation was limited to bacterial microorganisms isolated from the collected samples and did not include viruses, parasites, fungi, or other microbial agents. The samples used in the testing involved selected parts of the specimens, namely their tail and external body parts or their shells, disregarding completely their intestines and the insides of the specimens.

Furthermore, the study focused solely on raw seafood samples and did not evaluate the effects of cooking, heat treatment, or other food preparation methods on bacterial survival and antimicrobial resistance patterns. Environmental factors including water quality, tidal conditions, and handling practices during collection were not examined in this study. Additionally, the antimicrobial susceptibility testing results presented in this study are experimental in nature and should therefore be interpreted with caution. Variations in microbial response, laboratory conditions, and methodological limitations may contribute to possible discrepancies in the findings. Consequently, the results remain subject to further verification and clarification, and an acceptable margin of error must be considered in the interpretation of the antimicrobial susceptibility profiles.

MATERIALS AND METHODS

Research Design

This study employed a quantitative research design with a descriptive cross-sectional approach. The design allowed the researchers to examine bacterial presence and resistance profiles at a single moment in time without changing environmental or biological variables, guaranteeing that the results mirrored the real microbial condition of the samples as obtained from the study area.

Samples were obtained through purposive sampling, a non-probability technique, from the coastal areas of Barangay Barra, Tudela, Misamis Occidental. This method involves the selection of samples based on specific characteristics directly relevant to the research objectives (Patton, 2015), thus ensuring that only edible seafood species of interest were included in the study to avoid discrepancies of results.

The laboratory procedures included isolating, identifying, and testing the susceptibility of bacteria to antimicrobial agents. The VITEK AST system was chosen due to its high reliability, standardized methods, and ability to quickly produce susceptibility profiles for Gram-negative bacteria. Using this system ensured consistent results and allowed for comparison with the Clinical and Laboratory Standards Institute (CLSI) guidelines. Additional confirmatory tests, such as presumptive and completed coliform testing on Eosin Methylene Blue (EMB) Agar were performed to enhance the accuracy of

bacterial identification and minimize the risk of false-positive outcomes.

Overall, the selected design and methods were suitable as they allowed for a systematic, time-specific, and evidence-based evaluation of microbial contamination and antimicrobial resistance in the chosen seafood species. This method produced dependable baseline data that can support public health surveillance, environmental analysis, and further studies on the safety of marine microbes.

Research Setting

The specimen collection for this study was conducted at Tudela, Misamis Occidental, especially in the coastal areas of Barangay Barra (8.2469° N, 123.8536° E), as shown in Figure 1, where lamp shell *(Lingula anatina Lamarck, 1801)*, and peanut worm *(Sipunculus nudus Linnaeus, 1766)* are harvested for consumption and are sold for a living.

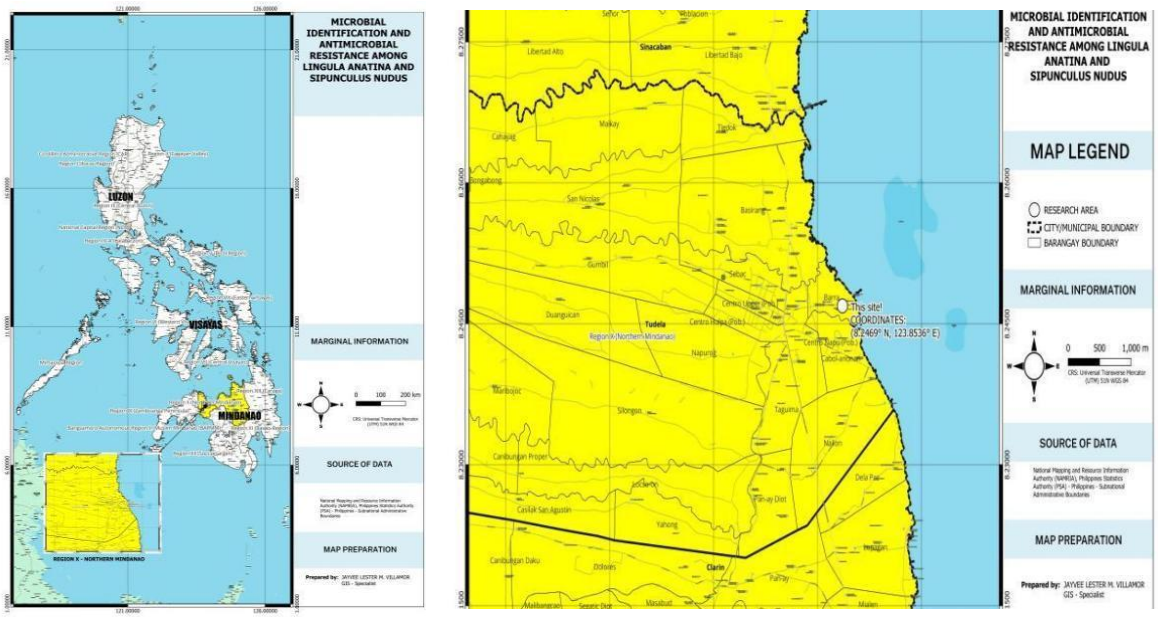

Figure 1. Collection site of the Lamp Shell (*Lingula anatina*) and Peanut Worm (*Sipunculus nudus*) samples in Barangay Barra, Tudela, Misamis Occidental

Sample Collection

Most of the locals that live near these coastal areas collect lamp shells and peanut worms (Figure 2) as part of their livelihood, thus, the researchers opted to communicate with the locals for assistance in the collection of the samples used in the study. A total of 350 g of each sample were bought from local gatherers who in turn collected samples during low tide. Lamp shell and peanut worm were obtained by digging them beneath the sand or mud using a shovel or core sampler. The sample collection and transportation procedure are illustrated in Figure 3. After that, samples were stored in a cooler which contained ice at 7°C-10°C to ensure proper temperature and prevent bacterial proliferation. The samples were then transported to the laboratory within 2-3 hours (Pakingking., 2022).

(a) (b)

Figure 2. Seafood samples (a) Peanut worm (*Sipunculus nudus*) and (b) Lamp shell (*Lingula anatina*)

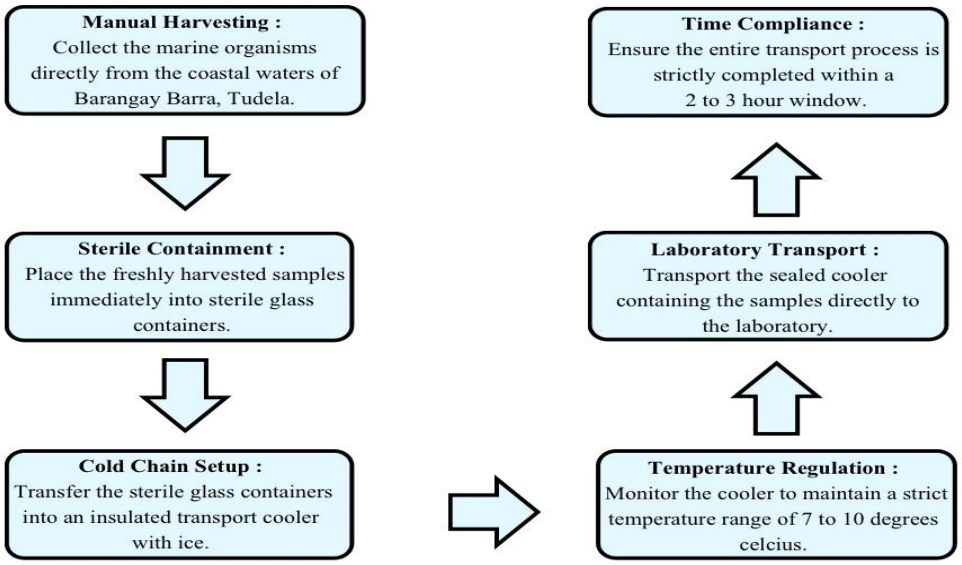

Figure 3. Schematic diagram of the sample collection and transportation process

Sampling Procedure

All samples were rinsed with sterile saline to remove remaining sand attached. After making sure that they are properly rinsed, samples were placed in a sterile beaker and dissected. A sterile scissor was used to cut lamp shell pedicles. The soft tissue inside the shell and intestinal contents were removed. Meanwhile, peanut worm samples were also dissected using sterile scissors to open the coelomic cavity and remove the visible sediments and gut content (Liu, C. et al., 2023). Samples were then rinsed again to make sure that only the part of the seafood that can be eaten raw would be processed in homogenization. The detailed steps involved in sample preparation for testing are presented in Figure 4.

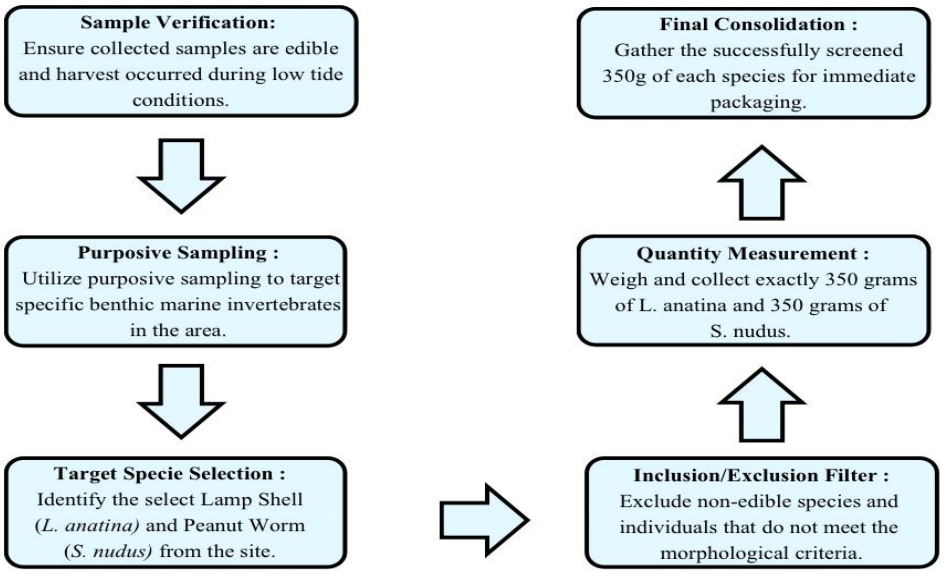

Figure 4. Schematic diagram of the Sample preparation for testing

Microbial Isolation and Identification

The researchers adapted a procedure based on the U.S. Food and Drug Administration (FDA) Bacteriological Analytical Manual (BAM, 2020), with modifications adapted from studies by Yulistiani et al. (2021), Sitowski et al. (2025), and Atwill et al. (2021). As presented in Figure 5, the procedure to isolate the coliform bacteria required 25 grams of each seafood sample that were then aseptically weighed and homogenized with 225 mL of Buffered Peptone Water (BPW) using a blender. Following that, a ten-fold serial dilution is made by transferring 1mL of homogenate and 9 mL BPW as diluent into the test tubes until it reaches to dilution 10^{4}. This was then incubated at 37°C for 18-24 hours to improve the recovery and proliferation of *Escherichia coli* cells as adopted from the procedure of Ullah et al. (2024). After incubation, a presumptive test

using lactose broth is performed. 1ml is obtained from each of the dilutions and then transferred into a test tube containing lactose broth with Durham tubes. This was further incubated for 48 hours within 37° C (Sitowski et al., 2025). All tubes were then visualized for possible gas production. The tubes that exhibit gas production are confirmed using the EC broth. Media. Correspondingly, a loopful amount is obtained from those tubes that exhibit gas production and inoculated into the tubes containing EC and Durham tubes, then incubated at 37° C for 48 hours. After 48 hours, all tubes were examined for bacterial growth. Gas production indicated a positive result, which was further confirmed using Eosin Methylene Blue (EMB) agar. Subsequently, 0.1 mL of the sample was inoculated onto the medium and incubated at 35°C for 24 hours. The expected result on this medium is the appearance of a green metallic sheen on the agar surface.

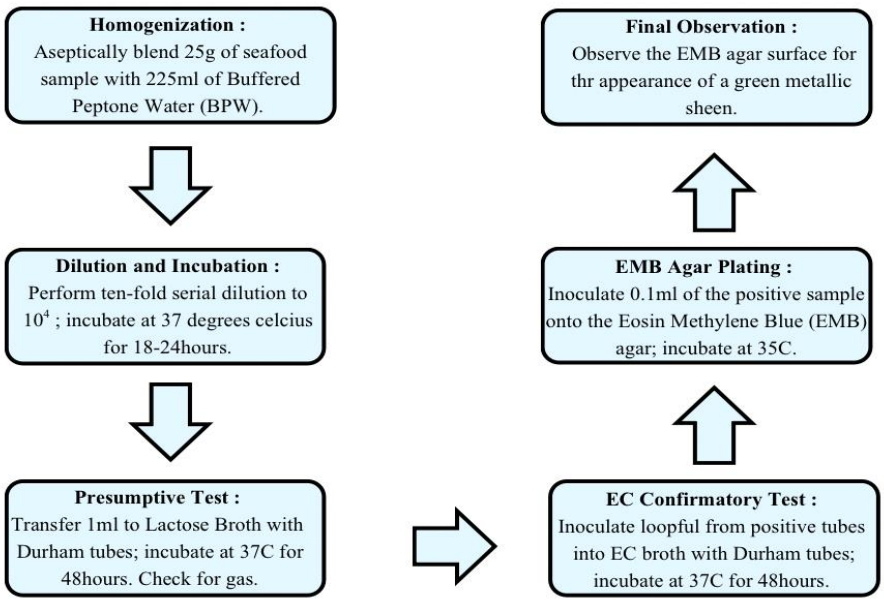

Figure 5. Schematic diagram of Microbial Isolation and Identification of *E. coli*

To conduct the analysis of *Vibrio* spp., the researchers adapted a procedure from the U.S. Food and Drug Administration (FDA) guidelines, Meza et al. (2022), Dumaloan-Canini et al. (2024), and the recent study by Lao et al. (2025). As illustrated in Figure 6, 25 grams of each sample were homogenized in 225 mL of 3% NaCl containing alkaline peptone water (pH 8.6) using a blender. The homogenized sample was incubated at 37°C for 18 hours, followed by serial dilution before further incubation. After that, 0.1 mL of the homogenate were streaked onto thiosulfate citrate bile salts sucrose agar media and incubated at 37°C for 18 hours. To ensure the reliability, analysis was performed in triplicate. The VITEK 2 system is used for further testing, serving as an automated biochemical test for the isolated bacteria.

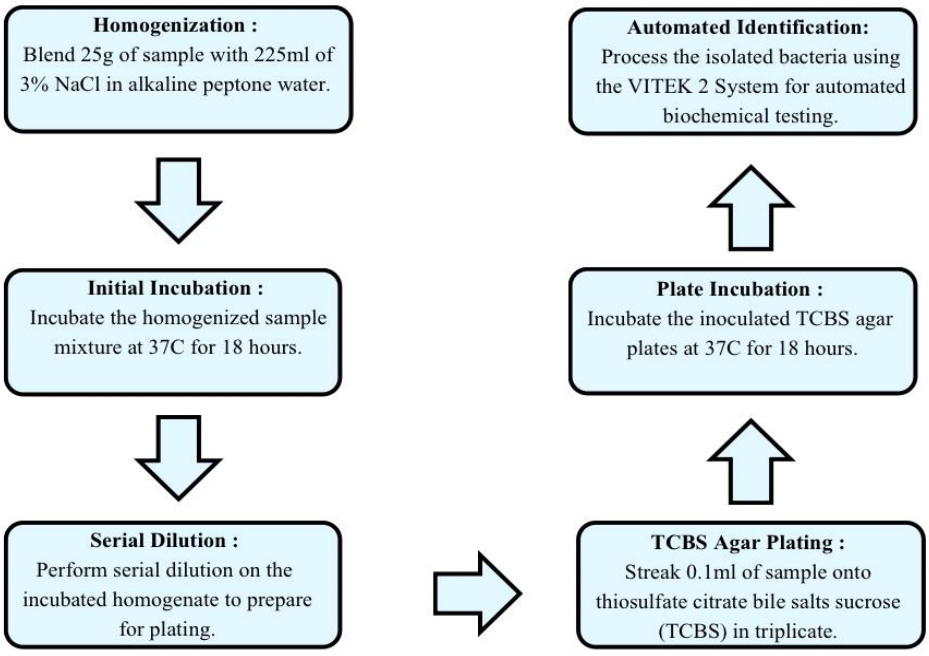

Figure 6. Schematic Diagram of Microbial Isolation and Identification of *Vibrio spp.*

Antimicrobial Susceptibility Test

The antimicrobial susceptibility profiles of bacterial isolates from *L. anatina* and *S. nudus* WERE determined USING on VITEK 2 system, following the Clinical and Laboratory Standards Institute (CLSI) guidelines (Clinical and Laboratory Standards Institute, 2025). Bacterial colonies isolated from pure cultures were suspended in sterile saline and adjusted to match the McFarland turbidity standard, as shown in Figure 7.

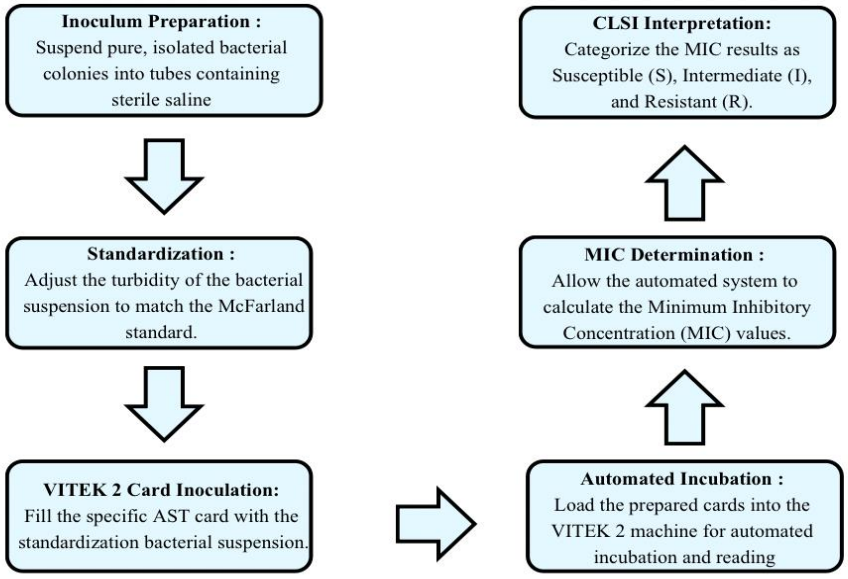

Figure 7. Schematic Diagram of Antimicrobial Susceptibility Testing of *L.anatina* and *S.nudus*

Data Analysis

The antibiotic resistance profiles of the bacterial isolates were assessed by compiling and analyzing all laboratory observations. The VITEK 2 system's numerical minimum inhibitory concentration (MIC) values were methodically documented. The

Clinical and Laboratory Standards Institute's standard breakpoints were then used to interpret these values (CLSI, 2025). The isolates were divided into three different susceptibility profiles based on these criteria, as shown in Table 1: susceptible (S), intermediate (I), or resistant (R). This qualitative classification made it possible to evaluate the possible effects of the marine food products on public health.

Descriptive statistical methods were employed to summarize the antimicrobial susceptibility data. The frequency and percentage of isolates classified under each susceptibility category were calculated. Mean MIC values were also determined to describe the overall susceptibility trends of the bacterial isolates. The analysis of resistance patterns provided valuable information regarding the potential role of seafood as a reservoir of antimicrobial-resistant bacteria and highlighted possible public health risks associated with contaminated marine food products.

Statistical Analysis

The quantitative data obtained from the antimicrobial susceptibility testing were subjected to descriptive statistical analysis to summarize the resistance profiles of the bacteria isolated from both *L. anatina* and *S. nudus* samples. The arithmetic mean (Ali, 2016) was calculated to summarize the MIC values, utilizing the following formula:

$$\bar{x} = \frac{\sum x}{n}$$

Where: **x = sum of all individual MIC values**

n = total number of observations (samples tested)

Table 1. Interpretative Categories and Minimal Inhibitory Concentration (MIC) Breakpoints, µg/mL

Antimicrobial	Susceptible (S)	Susceptible Dose-Dependent (SDD)	Intermediate (I)	Resistant
Ampicillin	≤ 8	-	16^	≥ 32
Amoxicillin/Clavulanic acid	≤ 8/4	-	16/8^	≥ 32/16
Ampicillin/Sulbactam	≤ 8/4	-	16/8^	≥ 32/16
Piperacillin/Tazobactam	≤ 8/4	16/4	-	≥ 32/4
Cefuroxime	≤ 8	-	16^	≥ 32
Cefuroxime Axetil	≤ 4	-	8–16^	≥ 32
Cefoxitin	≤ 8	-	16^	≥ 32
Cefotaxime	≤ 1	-	2^	≥ 4
Ceftazidime	≤ 4	-	8^	≥ 16
Cefepime	≤ 2	4–8	-	4–8
Ertapenem	≤ 0.5	-	1^	≥ 2
Meropenem	≤ 1	-	2^	≥ 4
Amikacin	≤ 4	-	8^	≥ 16
Gentamicin	≤ 2	-	4^	≥ 8
Ciprofloxacin	≤ 0.25	-	0.5^	≥ 1
Levofloxacin	≤ 0.5	-	1^	≥ 2
Trimethoprim/Sulfamethoxazole	≤ 2/38	-	-	≥ 4/76

Note: Antimicrobial susceptibility interpretations were based on the guidelines provide the Clinical and Laboratory Standards Institute (CLSI) M100,35th Edition: Performance Standards for Antimicrobial Susceptibility Testing (2025)

Ethical Considerations

Ethical considerations were observed throughout the study to ensure transparency, respect, and integrity. Prior to sample collection, coordination was made with the Local Government Unit (LGU) of Tudela, Barangay officials, Bureau of Fisheries and Aquatic Resources (BFAR) and the local gatherers. The cooperation of the community members was respectfully obtained, and their contributions to the collection process were appropriately recognized.

Only the appropriate number of *L. anatina* and *S. nudus* were collected to minimize

disturbance to the marine ecosystem. All laboratory analyses were conducted at the Department of Natural Sciences in Misamis University. Confidentiality will be maintained as no personal or identifying information from community members was collected, and all data were used strictly for academic purposes. If results reveal potential health risks, these will be communicated to the appropriate authorities for proper awareness and guidance.

Biosafety, Biosecurity, and Biowaste Management

This study adhered both safety and responsibility in every step to protect researchers and the environment. All samples were aseptically handled and testing procedures were conducted under a controlled laboratory environment at Misamis University and Mayor Hilarion A. Ramiro Sr. Medical Center (MHARS-MC) following standard biosafety protocols. During sample processing, researchers wore personal protective equipment particularly gloves, masks, and laboratory coats. Working environments were disinfected before and after testing to maintain a safe working environment and prevent cross-contamination during sample handling. All glasswares, metal instruments, culture media, and biological waste were autoclaved before and after each use and disposal. Biological waste generated during the study were then segregated and disposed of following institutional biosafety guidelines. This approach ensured that the study not only met scientific standards but also upheld health and environmental safety.

RESULTS AND DISCUSSIONS

Identification of Microbial Presence in Peanut Worm and Lamp Shell

Bacterial isolation and definitive microbial identification were conducted on the lamp shell *(L. anatina),* and the peanut worm *(S. nudus)* harvested from the coastal waters of Barangay Barra, Tudela, Misamis Occidental. The tests performed confirmed the presence of three distinct bacterial species indicating the presence of *Vibrio alginolyticus, Vibrio parahaemolyticus* and *Klebsiella pneumoniae* ssp *pneumoniae*. As shown in Table 2**,** both seafoods contained dangerous pathogens, with the VITEK system showing high confidence levels (87% to 99% probability matches*).*

Table 2. Summary of microorganisms detected in seafood samples collected from Tudela, Misamis Occidental

Seafood Sample	Identified Bacteria	Vitek Probability
Lamp Shell (LA)	*Vibrio parahaemolyticus*	96% & 99%
	Klebsiella pneumoniae ssp pneumoniae	92%
Peanut Worm (PW)	*Vibrio parahaemolyticus*	99% & 95%
	Vibrio alginolyticus	95%
	Klebsiella pneumoniae ssp pneumoniae	87%

One pathogenic bacterium identified in the seafood samples is *V. alginolyticus,* which is naturally abundant in marine and estuarine ecosystems and is widely distributed

in coastal waters worldwide (Sun et al., 2024). This bacterium is considered halophilic, meaning it thrives in saline environments, making seafood and coastal waters favorable reservoirs for its survival and proliferation. Environmental factors such as temperature and salinity greatly influence its growth and persistence. Studies have shown that *V. alginolyticus* can survive at temperatures ranging from 5°C to 42°C, with accelerated growth commonly observed between optimal growth occurring at approximately 22°C and 37°C and optimal growth occurring at approximately 35°C ± 2°. The expansive thermo- and halotolerance of *V. alginolyticus* suggests that this bacterium is well adapted to tropical/temperate waters and may only be limited within these systems by seasonal cooling, the presence of freshwater input, and/or atypical hypersaline environments (Norfolk et al., 2023).

The presence of *V. alginolyticus* in seafood is a significant public health concern because this pathogen is recognized as one of the major causative agents of marine vibriosis. Human infection may occur through the consumption of contaminated seafood, particularly raw or undercooked shellfish and fish products or through exposure to open wounds to contaminated water. Clinical manifestations commonly include gastroenteritis, diarrhea, abdominal pain, vomiting, wound infections, and septicemia in severe cases. Individuals who are immunocompromised, elderly, or suffering from chronic diseases are more susceptible to severe infections and complications (Cai et al., 2024). Moreover, environmental changes such as rising sea surface temperatures associated with climate change may further contribute to the increased prevalence and distribution of *Vibrio* spp. in marine environments, potentially elevating the risks of seafood-associated infections.

On the other hand, *V. parahaemolyticus* is a major foodborne pathogen commonly

contaminating seafood, most prominently when consumed raw or uncooked (Ndraha et al., 2022). This pathogen is recognized globally as one of the leading causes of seafood-borne gastroenteritis. This bacterium commonly contaminates marine fish, shellfish, shrimp, oysters, and other seafood products, particularly when these are consumed raw, improperly handled, or insufficiently cooked (Ndraha et al., 2022). Similar to other *Vibrio* spp., *V. parahaemolyticus* thrives in warm coastal waters and areas with relatively lower salinity conditions that favor its growth and multiplication (Rincé et al., 2018).

In humans, infections caused by *V. parahaemolyticus* are commonly manifested through acute gastroenteritis characterized by diarrhea, nausea, vomiting, abdominal cramps, fever, and stomach pain. In more severe cases, particularly among immunocompromised individuals or patients with underlying medical conditions, the infection may progress to septicemia and other systemic complications (Faulkova et al., 2024). The pathogenicity of this bacterium is often associated with virulence factors such as thermostable direct hemolysin (TDH) and TDH-related hemolysin (TRH), which contribute to intestinal damage and disease development. Furthermore, *Vibrio* spp. may enter seafood organisms through ingestion, filtrations, or skin abrasions. Thus, contamination can occur through internalization via mouth, gills, digestive tract, or damaged skin tissues of aquatic organisms (Brauge et al., 2024). Poor sanitation, contaminated harvesting waters, and improper post-harvest handling practices may also contribute to persistence and spread of the bacterium in seafood products intended for human consumption.

Meanwhile, *K. pneumoniae* is a gram-negative, encapsulated bacterium belonging to the *Enterobacteriaceae* family. Although it is commonly associated with hospital-

acquired infections, this opportunistic pathogen has also been isolated from marine environments and seafood products, indicating possible contamination from human, agricultural, or environmental sources (Jin et al., 2025). *K. pneumoniae* naturally colonizes the gastrointestinal tract and mucosal surfaces of humans and animals. However, it may cause serious infections such as pneumonia, urinary tract infections, bloodstream infections, liver abscesses, and septicemia. The pathogenicity of *K. pneumoniae* bacteria is associated with several virulence factors that allow it to evade the host's innate immune mechanisms that include capsules, exopolysaccharides associated with mucoviscosity, lipopolysaccharides (LPSs), adhesins, and iron uptake systems. The factors that aggravate the infection caused by *K. pneumoniae* are multiple antibiotic resistance and its ability to cause nosocomial infections in humans (Riwu et al., 2022). This has become a major concern in the healthcare setting due to its high incidence rate and significant drug resistance, particularly amongst immunocompromised individuals (Martin et al., 2018). The emergence of these resistant strains has made infections increasingly alarming and difficult to treat and has significantly contributed to the rising burden of nosocomial infections worldwide. Consequently, the detection of this bacterium in seafood products highlights potential public health risks and underscores the importance of maintaining proper hygiene, environmental sanitation, and antimicrobial stewardship to prevent the dissemination of resistant pathogens through the food chain (Martin et al., 2018).

Antimicrobial Resistance Profile

A total of 15 isolates passed quality control metrics and were tested for further confirmation using the VITEK system, which provides Antimicrobial Susceptibility Testing (AST) results along with microbial identification. According to Kareem et al. (2022), the VITEK II compact system is used to identify microorganisms particularly bacteria, yeast, and molds automatically, and uses the technique of applied advanced colorimetry cards. This system yields the identification and classification of microorganisms through comparing the results to recognized microbial species-specific responses.

Out of the 15 isolates, 10 were successfully identified as clinically relevant bacteria. The antimicrobial susceptibility results revealed distinct resistance and susceptibility patterns among the identified organisms.

Vibrio species Isolates

The identified *Vibrio* spp. were *V. parahaemolyticus and V. alginolyticus.* According to Karatuna et al. (2024), these species are frequently tested against various antibiotics, such as piperacillin/tazobactam, cefotaxime, ceftazidime, meropenem, ciprofloxacin, levofloxacin, and trimethoprim/sulfamethoxazole. The antimicrobial susceptibility patterns observed were similar for both *V. parahaemolyticus and V. alginolyticus* with resistance noted against ampicillin.

Nevertheless, these isolates showed susceptibility to several antibiotic classes, including fluoroquinolones, aminoglycosides, carbapenems, and third- and fourth-

generation cephalosporins. These findings indicate the development of β-lactam resistance but also suggest that other important clinical antibiotics remain effective against these species.

Antibiotic Resistance and Susceptibility Profile of *Vibrio spp.*

The antimicrobial susceptibility profiles, shown in Table 3 and 4, demonstrated a consistent pattern among *V. parahaemolyticus* and *V. alginolyticus* isolates, wherein resistance was observed against ampicillin, while susceptibility was maintained against several other antimicrobial classes, including fluoroquinolones, aminoglycosides, carbapenems, and third- and fourth-generation cephalosporins. These findings indicate that although resistance to selected β-lactam agents has emerged, several clinically important antibiotics remain effective against these isolates.

Antibiotics are commonly used in aquaculture to treat bacterial infections, which most *Vibrio* spp. are susceptible to them. However, pathogens have acquired resistance due to widespread and frequent use of these antibiotics (Kah Sem et al., 2023). *V. parahaemolyticus* and *V. alginolyticus* isolates were uniformly resistant to commonly used antimicrobials, especially β-lactams such as ampicillin (MIC ≥32), uniformly intermediate to cefuroxime (MIC =16), which is also a β-lactam antibiotic, while cefoxitin showed variable susceptibility.

Table 3. ***Vibrio parahaemolyticus*** **antimicrobial susceptibility profile**

	Lamp Shell		Peanut Worm	
Antimicrobial	**Mean**	**Interpretation**	**Mean**	**Interpretation**
Ampicillin	≥ 32	R	≥ 32	R
Amoxicillin/Clavulanic acid	≤ 2	S	≤ 3	S
Ampicillin/Sulbactam	≤ 2	S	≤ 3	S
Piperacillin/Tazobactam	≤ 4	S	≤ 4	S
Cefuroxime	16	I	16	I
Cefuroxime Axetil				
Cefoxitin	9	S	≤ 11	S
Cefotaxime	≤ 0.25	S	≤ 0.25	S
Ceftazidime	0.7	S	≤ 0.5	S
Cefepime	≤ 0.2	S	≤ 0.12	S
Ertapenem				
Meropenem	≤ 0.25	S	≤ 0.25	S
Amikacin	12	S	≤ 7	S
Gentamicin	≤ 1	S	≤ 1	S
Ciprofloxacin	0.1	S	≤ 0.12	S
Levofloxacin	≤ 0.12	S	≤ 0.12	S
Trimethoprim/Sulfamethoxazole	≤ 20	S	≥ 20	S

According to Tan et al. (2022), lactam antibiotics inhibit the cross-linking between adjacent polysaccharide chains and peptides in the peptidoglycan layer of bacteria, where mur enzymes are present. These enzymes catalyze linking of key amino acid residues with stem peptides and promote peptidoglycan synthesis, a key target for bacterial resistance. In Gram-negative bacteria, production of β-lactamases is often induced in response to the antibiotic-associated damage to the cell wall.

Table 4. ***Vibrio alginolyticus*** **(Isolate Peanut worm, A2, TCBS-1) antimicrobial susceptibility profile**

Antimicrobial	MIC	Interpretation
Ampicillin	≥ 32	R
Amoxicillin/Clavulanic acid	4	S
Ampicillin/Sulbactam	4	S
Piperacillin/Tazobactam	≤ 4	S
Cefuroxime	16	I
Cefuroxime Axetil	-	-
Cefoxitin	16	I
Cefotaxime	≤ 0.25	S
Ceftazidime	0.5	S
Cefepime	≤ 0.12	S
Ertapenem	-	-
Meropenem	≤ 0.25	S
Amikacin	8	S
Gentamicin	≤ 1	S
Ciprofloxacin	0.12	S
Levofloxacin	≤ 0.12	S
Trimethoprim/Sulfamethoxazole	≤ 20	S

Ampicillin has historically been utilized in the treatment of respiratory tract infections, urinary tract infections, gastrointestinal infections, and systemic bacterial diseases caused by susceptible organisms (Peechakara et al., 2023). However, all *Vibrio* isolates in this research study demonstrated resistance to ampicillin (MIC ≥32). Studies have shown *V. parahaemolyticus* isolated from seafood frequently exhibits high resistance to ampicillin. Stratev et al. (2023) suggests that ampicillin may no longer be a reliable therapeutic option against *Vibrio* spp. as sea water, fish, and shellfish strains are highly resistant to it.

In contrast, amoxicillin/clavulanic acid and ampicillin/sulbactam demonstrated susceptibility across all *Vibrio* isolates. β-lactamase inhibitors are designed to restore the

activity of β-lactam antibiotics against organisms producing β-lactamases by preventing enzymatic hydrolysis of the β-lactam agent (Bush & Bradford, 2021). The observed susceptibility among isolates may suggest that resistance mechanisms affecting these organisms do not completely overcome β-lactamase inhibitor activity. These findings indicate that β-lactam/β-lactamase inhibitor combinations may remain active against environmental *Vibrio* isolates, although additional resistance mechanisms may emerge with continued antimicrobial exposure.

Piperacillin/tazobactam similarly demonstrated complete susceptibility among isolates. Piperacillin is classified as an extended-spectrum ureidopenicillin commonly used for severe Gram-negative bacterial infections, while tazobactam functions as a β-lactamase inhibitor that enhances antimicrobial activity against β-lactamase-producing organisms (Bush & Bradford, 2021). According to Karatuna et al. (2024), *Vibrio* spp. generally remain susceptible to piperacillin/tazobactam, supporting its role as an effective antimicrobial option for serious *Vibrio*-associated infections.

Cefotaxime and ceftazidime, both third-generation cephalosporins, exhibited uniformly low MIC values and susceptibility patterns among all isolates. These agents are commonly utilized in the management of septicemia, meningitis, and severe Gram-negative infections because of their broad-spectrum activity and increased stability against many β-lactamases (Arumugham et al., 2023).

Cefepime, a fourth-generation cephalosporin with enhanced activity against Gram-negative organisms and improved stability against chromosomal β-lactamases, also demonstrated consistent susceptibility (Arumugham et al., 2023). Cefepime has broader Gram-negative coverage and greater stability against β-lactamases than many earlier-

generation cephalosporins. The effectiveness of these cephalosporins suggests that resistance mechanisms affecting penicillin derivatives may not extend equally across all cephalosporin subclasses.

The susceptibility of meropenem further demonstrated the preservation of carbapenem effectiveness among the isolates. Carbapenems remain important therapeutic agents for severe multidrug-resistant Gram-negative infections because of their broad-spectrum antimicrobial activity and their stability against many β-lactamases (Jean et al., 2022). The observed susceptibility may suggest the absence of advanced resistance mechanisms such as carbapenemase production among the *Vibrio* isolates recovered in this study. However, definitive confirmation of carbapenemase absence requires molecular analysis or phenotypic confirmatory testing beyond antimicrobial susceptibility testing alone, as susceptibility profiles alone cannot reliably determine carbapenemase production (Hosoda et al., 2021; Zhang et al., 2021).

The aminoglycosides amikacin and gentamicin also demonstrated susceptibility among isolates. These antibiotics inhibit bacterial protein synthesis by irreversibly binding to the bacterial 30S ribosomal subunit, leading to disruption of protein translation and bacterial cell death (Krause et al., 2016). Aminoglycosides are commonly utilized in severe systemic infections, including sepsis and complicated Gram-negative infections, because of their rapid and potent bactericidal activity against Gram-negative organisms (Thy et al., 2023).

Furthermore, ciprofloxacin and levofloxacin, both fluoroquinolones, demonstrated very low MIC values and consistent susceptibility. Fluoroquinolones exert their antimicrobial effect by inhibiting bacterial DNA gyrase and topoisomerase IV, enzymes

essential for DNA replication, transcription, and repair (Hooper & Jacoby, 2016). These drugs are frequently utilized in gastrointestinal infections and are commonly recommended for severe *Vibrio* infections because of their broad-spectrum activity and favorable tissue penetration (Baker-Austin et al., 2018).

According to Kah Sem et al. (2023), fluoroquinolones remain among the preferred therapeutic options against *Vibrio* infections because of their potent antimicrobial activity and favorable pharmacokinetic properties. The findings suggest that these drugs continue to demonstrate potential therapeutic activity against *Vibrio* species isolated from seafood environments.

The antimicrobial patterns observed in *Vibrio* isolates indicate selective resistance primarily targeting β-lactam antibiotics while maintaining susceptibility toward several broad-spectrum antimicrobial agents. Similar susceptibility patterns have been observed in environmental and seafood-associated *Vibrio* isolates, where resistance commonly develops against frequently used antibiotics before broader multidrug-resistant phenotypes emerge (Elmahdi et al., 2016; Kah Sem et al., 2023). These findings suggest that antimicrobial resistance among marine microorganisms may initially emerge against commonly used antibiotics before progressing toward more extensive multidrug resistance profiles.

Klebsiella pneumoniae **Isolates**

K. pneumoniae isolates were also found in the tested samples. As an opportunistic pathogen, *K. pneumoniae* is recognized for its capacity to gain and spread antimicrobial

resistance, especially through the production of Î²-lactamase enzymes and the process of horizontal gene transfer. In this study, the antimicrobial susceptibility profiles of *K. pneumoniae* were assessed using the same antimicrobial susceptibility testing (AST) method provided by the VITEK system, which enabled a standardized comparison with the CLSI interpretive guidelines.

Antibiotic Resistance and Susceptibility Profile of *Klebsiella pneumoniae spp.*

K. pneumoniae ssp. *pneumoniae* isolates are shown in table 5 demonstrated consistent resistance to ampicillin, with variable susceptibility patterns toward other β-lactam agents. These observations may reflect the presence of intrinsic and acquired resistance mechanisms associated with *K. pneumoniae*.

According to Zhang et al. (2023), β-lactam resistance in *K. pneumoniae* is associated with the production of β-lactamases that hydrolyze β-lactam antibiotics and reduce their antimicrobial activity. Porin alterations, reduce antibiotic penetration into bacterial cells and contribute to antimicrobial resistance in *K. pneumoniae,* acting together with β-lactamase activity and increased efflux pump expression enhance resistance in *K. pneumoniae* (Gogoi et al., 2023). These mechanisms reduce antibiotic penetration and enhance bacterial survival despite antimicrobial exposure.

Table 5. Klebsiella pneumoniae ssp. pneumoniae antimicrobial susceptibility profile

	Lamp Shell		Peanut Worm	
Antimicrobial	**Mean**	**Interpretation**	**Mean**	**Interpretation**
Ampicillin	≥ 32	R	≥ 32	R
Amoxicillin/Clavulanic acid	≤ 2	S	≤ 2	S
Ampicillin/Sulbactam	≥ 32	R	4	S
Piperacillin/Tazobactam	≤ 4	S	≤ 4	S
Cefuroxime	24	I	2	S
Cefuroxime Axetil	24	I	2	S
Cefoxitin	≤ 4	S	≤ 4	S
Cefotaxime	≤ 0.25	S	≤ 0.25	S
Ceftazidime	2.06	S	≤ 0.12	S
Cefepime	≤ 0.12	S	≤ 0.12	S
Ertapenem	≤ 0.12	S	≤ 0.12	S
Meropenem	8	R	≤ 0.25	S
Amikacin	≤ 1	S	≤ 1	S
Gentamicin	≤ 1	S	≤ 1	S
Ciprofloxacin	≤ 0.06	S	≤ 0.06	S
Levofloxacin	≤ 0.56	I	≤ 0.12	S
Trimethoprim/Sulfamethoxazole	≤ 20	S	≥ 320	R

Ding et al. (2023) & Tseng et al. (2023) states that carbapenem resistance in *K. pneumoniae* is associated with carbapenemase enzymes and their variants, plasmid-mediated resistance genes, and modifications of membrane porins that reduce antimicrobial entry into bacterial cells, which have become a major global public health concern as carbapenems are often considered drugs of last resort for multidrug-resistant Gram-negative infections. The presence of meropenem resistance within environmental isolates may indicate emerging resistance determinants that require close monitoring because of their potential public health implications.

The maintained susceptibility toward cefotaxime, ceftazidime, cefepime, amikacin, gentamicin, ciprofloxacin, and levofloxacin in most isolates suggests that resistance mechanisms may not be broadly expressed across all antimicrobial classes. Susceptibility to these agents suggests that although selected β-lactam resistance mechanisms are present, broader multidrug resistance mechanisms may not yet be extensively expressed among the isolates recovered in this study. Similar findings have been reported in environmental *K. pneumoniae* isolates, where resistance tends to develop selectively against specific antimicrobial classes before progressing into broader multidrug-resistant phenotypes (Navon-Venezia et al., 2017; Martin & Bachman, 2018).

The presence of antimicrobial-resistant *K. pneumoniae* in seafood environments raises public health concerns because environmental reservoirs may facilitate the dissemination of resistance genes through aquatic ecosystems and food chains. Resistance genes may be transferred through horizontal gene transfer mechanisms, including plasmid exchange, transposons, and integrons, contributing to the spread of antimicrobial resistance among bacterial populations (Partridge et al., 2018). Therefore, continuous surveillance and antimicrobial susceptibility monitoring remain essential to limit the distribution of resistant organisms and preserve antimicrobial effectiveness.

In summary, the results indicated that the microbial microorganisms obtained from lamp shells *(L. anatina)* and peanut worm *(S. nudus)* showed resistance to commonly used antibiotics, such as ampicillin, and intermediate susceptibility to cefuroxime, suggesting the presence of antimicrobial resistant strains of *Vibrio* spp. and *Klebsiella* ssp. in the coastal waters of Barangay Barra, Tudela, Misamis Occidental. This supports existing

concerns that coastal environments act as reservoirs for resistant microorganisms due to their exposure to antibiotic residues and environmental contamination.

Assessment of Health Risks

In communities, communal toilets play a critical role in serving the right to sanitation in public areas and are trying to promote inclusive, sustainable urban development (Akaishi et al., 2021). The disposal of untreated human wastes into water or tidal mudflats along the waterfront communities is linked to public health (Okon et al., 2017).

Contamination of coastal water bodies such as estuaries, creeks and backwaters occur due to direct discharge of domestic sewage and as a consequence, shellfish harvested from such water bodies harbor enteric pathogens. This condition predisposes coastal communities to faeco-oral infections transmitted by the consumption of contaminated food and water (Kumar et al., (2017).

V. alginolyticus, is an opportunistic pathogen commonly associated with infections resulting from the consumption of raw or undercooked seafood and the ingestion of contaminated water (Mohebi et al., 2022). *V. alginolyticus* is naturally present in marine and estuarine waters (Gao et al., 2024). Bathing or being in close contact with water contaminated with *Vibrio* spp. poses a risk of infection if the person has an open wound (Karatuna et al., 2023). V. alginolyticus is an emerging opportunistic pathogen to humans that causes foodborne diarrhoea in coastal areas (Baker-Austin et al., 2018). Additionally, it may cause gastrointestinal infections, ear infections, wound infections, otitis, and

endophthalmitis (Zheng et al., 2011). This bacterium also has pathogenic effects on marine organisms, including farm fish, molluscs, shellfish, and shrimp (Wang et al., 2020).

V. parahaemolyticus is considered the leading cause of bacterial gastroenteritis associated with seafood consumption commonly found in coastal areas (U. S Food and drug Administration., 2024). According to a study of Ngasotter (2022), *V. parahaemolyticus* can also infect open wounds that are exposed to seawater and cause septicemia, wound infection or ear infection, aside from being a human pathogen it is also considered an aquatic zoonotic pathogen (Martinez - Urtaza and Baker-Austin., 2020). This bacterium is a leading cause of infectious diarrhea globally, with coastal regions being particularly susceptible, which is often attributed to the consumption of raw or undercooked seafood (Baker-Austin *et al.*, 2017; Saha *et al.*, 2020). *V. parahaemolyticus* infections can precipitate severe symptoms including shock, diarrhea, and vomiting, posing significant public health risks, especially for individuals with underlying medical conditions such as liver disease or immune disorders (Baker-Austin *et al.*, 2018).

K. pneumoniae ssp *pneumoniae,* is a clinically Gram-negative pathogen increasingly recognized for its ability to cause a wide range of infections, particularly in hospitalized and immunocompromised patients (Abbas et al., 2024), but it has also been increasingly detected in various environmental and food sources, including seafood, where it may serve as a potential indicator of fecal contamination and poor hygienic handling practices (Dong et al., 2022).

It can be present in seafood due to contamination along the food chain, especially under poor hygiene and sanitation, making it a potential reservoir and transmission route to humans. Its detection in food is important because it is associated with opportunistic

infections, highlighting the need for strict food safety and proper handling practices (Riwu et al., 2022). The presence of *K. pneumoniae* in seafood is significant because ingestion of contaminated products can lead to gastrointestinal disturbances and in vulnerable populations such as immunocompromised individuals, may progress to more severe infections such as pneumonia, urinary tract infections, or septicemia (Oliveira et al., 2014).

In addition to that, the presence of antibiotic-resistant bacteria in coastal environments may facilitate the spread of resistant strains through contaminated seafood consumption, direct human exposure, and environmental transmission, posing significant risks to community health and food safety. Continuous monitoring, proper sanitation practices, and responsible antibiotic use are therefore essential to minimize the emergence and transmission of antimicrobial resistance in marine ecosystems.

CONCLUSION AND RECOMMENDATIONS

Pathogenic bacteria such as *V. parahaemolyticus, V. alginolyticus, and K. pneumoniae* were found in lamp shells *(L. anatina)* and peanut worms *(S. nudus)* from Barangay Barra, Tudela, Misamis Occidental. The results of antimicrobial susceptibility testing revealed resistance to ampicillin and reduced susceptibility to some antibiotics, suggesting antimicrobial-resistant bacteria were present in these samples. These results suggest a potential public health risk associated with the consumption of these marine organisms, especially when improperly handled or undercooked.

This study recommends that proper food safety practices must be strictly enforced including thoroughly cleaning, correctly storing, and fully cooking lamp shells and peanut worms before they are eaten to lower the chance of infection. Strict hygiene standards should also be maintained while gathering and preparing these organisms, to avoid contamination or the spread of contaminants. Local government units are urged to upgrade coastal sanitation, oversee collection areas, and manage waste and sewage properly, in order to cut down on microbial pollution in marine environments. Health agencies should step up public information efforts to teach people about safe seafood handling and the risks of antimicrobial resistance. Additionally, future research should look into other coastal species and cover more sampling locations, to get a clearer picture of how widespread microbial contamination is and how resistance patterns develop in marine ecosystems.

DECLARATION OF THE USE OF AI TOOLS

The researchers acknowledge the use of digital and AI assisted tools during the preparation of this study. These tools were utilized solely to support the writing process, enhance the clarity and organization of the manuscript, assist in paraphrasing, and facilitate the identification and formatting of scholarly references. All research activities, data analysis, interpretation of findings, and final conclusion were conducted, reviewed, and verified by the researchers.

The authors take full responsibility for the accuracy, and integrity presented in this study. Any information generated with the assistance of AI tools was critically evaluated to ensure compliance with academics.

The following tools and prompts were used:

ChatGPT (https://chat.openai.com) was used to assist in improving sentence structure, also to improve the flow of ideas, paraphrasing selected portions, and enhancing the overall clarity of the discussion.

- “Acting as a researcher conducting a thorough research, provide a selection of comprehensive literature and studies containing information on the brachiopod species Lingula anatina, specifically focusing on its morphology, habitat, and evolutionary biology. You must restrict your sources, research findings, and

citations to publications released within the last 5 years, and include full, verifiable URLs or DOI links for every reference provided."

- "Act as a medical research assistant and compile a preliminary list of peer-reviewed studies, clinical trials, and official health reports on antimicrobial resistance published within the last 5 years, including full source links or citations, so that I can personally evaluate and verify them before choosing which ones to use in my final research."
- "Act as an expert copyeditor and provide a few alternative ways to rephrase this section to remove repetitive words and improve readability, but do not alter any of the core contents or facts, as I will review your suggestions before deciding which ones to apply."

QuillBot (https://quillbot.com) was used to paraphrase selected statements and improve readability while preserving the original meaning and intent of the text.

- "Rewrite the selected text to enhance readability and preserve the original intent. Please modify it to be formal and scientific for a research paper, use simpler wording, make it more concise, and fix any grammar errors."
- "Paraphrase the text below to improve readability while strictly preserving the original meaning and intent. Apply these exact commands: rephrase it in a formal and scientific style suitable for a research paper, use simpler wording where helpful, rewrite it to enhance conciseness, and edit to improve grammar. I will be checking it after and deciding which ones to keep for my final paper."

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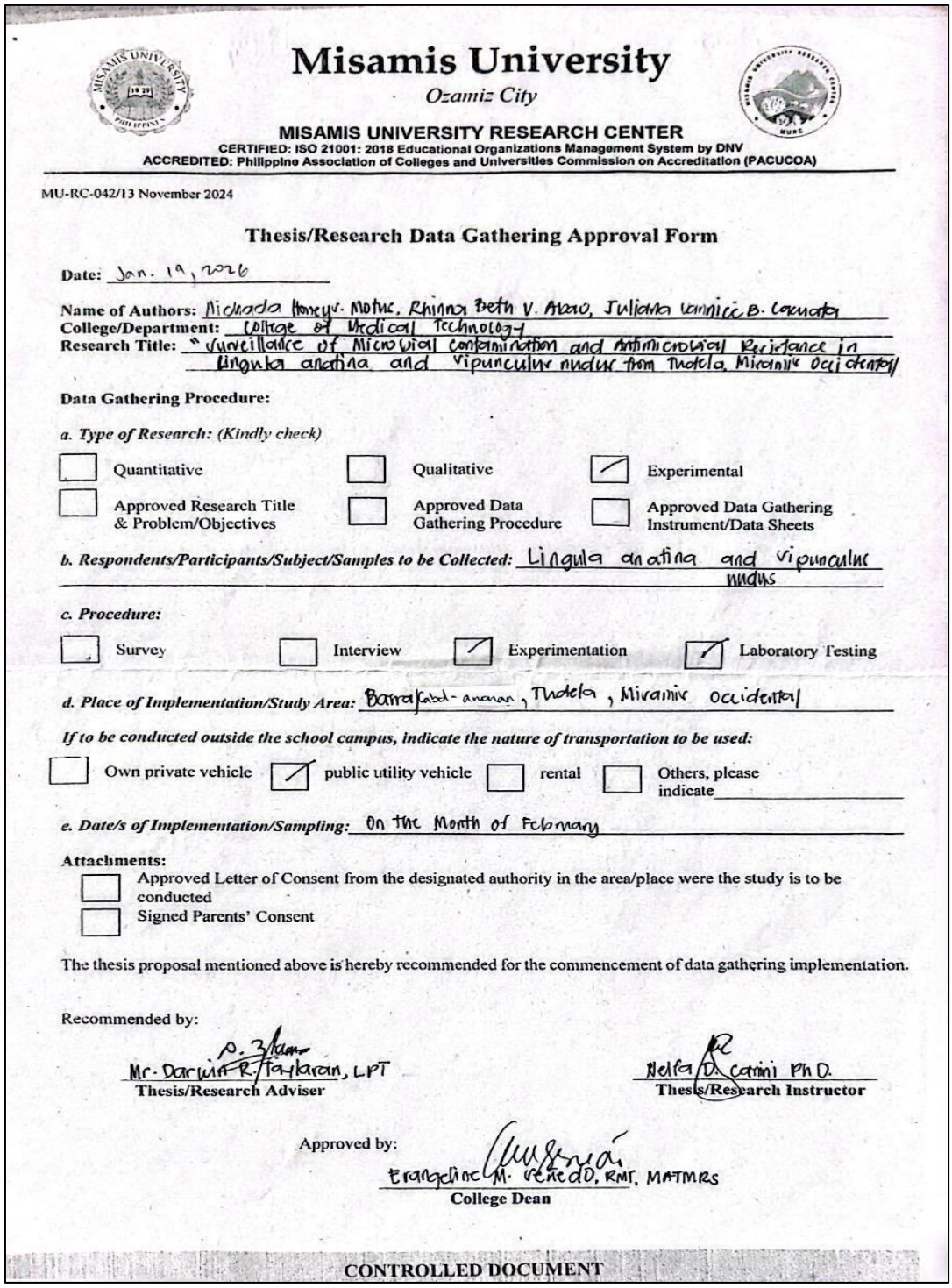
APPENDIX A. INFORMED CONSENT FORMS



Misamis University
Ozamiz City

MISAMIS UNIVERSITY RESEARCH CENTER
CERTIFIED: ISO 21001: 2018 Educational Organizations Management System by DNV
ACCREDITED: Philippine Association of Colleges and Universities Commission on Accreditation (PACUCOA)

MU-RC-042/13 November 2024

Thesis/Research Data Gathering Approval Form

Date: Jan. 19, 2026

Name of Authors: Michaela Honeyv. Motus, Rhinna Beth V. Abao, Juliana Vannice B. Lacuesta
College/Department: College of Medical Technology
Research Title: "Surveillance of Microbial Contamination and Antimicrobial Resistance in Lingula anatina and Vipunculus nudus from Tudela, Misamis Occidental"

Data Gathering Procedure:

a. Type of Research: (Kindly check)

- [ ] Quantitative
- [ ] Qualitative
- [x] Experimental
- [ ] Approved Research Title & Problem/Objectives
- [ ] Approved Data Gathering Procedure
- [ ] Approved Data Gathering Instrument/Data Sheets

b. Respondents/Participants/Subject/Samples to be Collected: Lingula anatina and Vipunculus nudus

c. Procedure:

- [ ] Survey
- [ ] Interview
- [x] Experimentation
- [x] Laboratory Testing

d. Place of Implementation/Study Area: Barra/Sabi-anahan, Tudela, Misamis Occidental

If to be conducted outside the school campus, indicate the nature of transportation to be used:

- [ ] Own private vehicle
- [x] public utility vehicle
- [ ] rental
- [ ] Others, please indicate

e. Date/s of Implementation/Sampling: On the Month of February

Attachments:

- [ ] Approved Letter of Consent from the designated authority in the area/place were the study is to be conducted
- [ ] Signed Parents' Consent

The thesis proposal mentioned above is hereby recommended for the commencement of data gathering implementation.

Recommended by:

Mr. Darwin R. Taylaran, LPT
Thesis/Research Adviser

Nelfa D. Catini Ph D.
Thesis/Research Instructor

Approved by:

Evangeline M. Renedo, RMT, MATMRS
College Dean

CONTROLLED DOCUMENT

APPENDIX A. Cont'd

MISAMIS UNVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02June2023

PARENT'S CONSENT

Research
Sponsoring Group/Organization

I am allowing my son/daughter/ward, Rhinna Beth V. Abad, to join the sample Collection *(activity)* to be held on on the month of prior to March at Misc. Occ. under the supervision of Mr. Darwin R. Taylaran *(Adviser/Faculty)*.

I understand that Misamis University exercises the necessary safety precautions in this activity.

In consideration of the benefits to be derived from the above activity, I expressly waive any and all claims against the administration or any member of the faculty and staff of the Misamis University on account of any unforeseen accident or injury that my son/daughter/ward might incur in connection with the aforementioned activity.

Ludelda M. Vivino — 01/21/25
Signature over printed name of **Parent/Guardian** — Date

Rhinna Beth V. Abad — 01/21/25
Signature over printed name of **Student** — Date

Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.

SUBSCRIBED AND SWORN to before me, this 21 day JAN 2026 at OZAMIS CITY, Philippines, that the herein affiant personally came and appeared with his/her _____, as evidence of his/her personal identity.

Doc. No. 112
Page No. 24
Book No. 4
Series of 2026

ATTY. ROMALDO LACANIO TORRES
Notary Public for and
Municipality of Clarin, Misamis Occidental
Until
Notarial Commission No.:
Roll of Attorneys No.:
PTR No.
MCLE Compliance No.:
PTR Issued
IBP No.
TIN No.
Roll No.

(*For DSAS Personnel only*)

Attested by:

RODEL L. BALDADO, MHist, MAEd
OIC, Department of Student Affairs & Services

Date: _____

APPENDIX A. Cont'd

MISAMIS UNVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02June2026

PARENT'S CONSENT

MU - College of Medical Technology
Sponsoring Group/Organization

I am allowing my son/daughter/ward, Zaira Mich O. Garcia, to join the sample gathering phase of the research study *(activity)* to be held on the month of Feb to March at Misamis Occidental under the supervision of Mr. Dnevin R. Taglucan *(Adviser Faculty)*.

I understand that Misamis University exercises the necessary safety precautions in this activity.

In consideration of the benefits to be derived from the above activity, I expressly waive any and all claims against the administration or any member of the faculty and staff of the Misamis University on account of any unforeseen accident or injury that my son/daughter/ward might incur in connection with the aforementioned activity.

Geralyn O. Garcia
Signature over printed name of **Parent/Guardian**

07 - 02 - 2026
Date

Zaira Mich O. Garcia
Signature over printed name of **Student**

07 - 02 - 2026
Date

Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.

SUBSCRIBED AND SWORN to before me, this ___ day of 02 JUL 2026 Ozamiz City, Philippines, that the herein affiant personally came and appeared with his/her _____, as evidence of his/her personal identity.

ATTY. REY B. BUNAG, RMT
Notarial Commission No. 2025-18
Notary Public for Ozamiz City and Clarin
City Hall Drive, Bernad Subdivision, Aguada, Ozamiz City
PTR No. 6007751; 01/05/2026; Ozamiz City
IBP O.R. No. 576165; 12/29/2025; Pasig City
Attorney's Roll No. 70548
MCLE Compliance No. VIII-0014127; Valid until 04/14/2028

Doc. No. 494
Page No. 99
Book No. XVII
Series of 2026

Notary Public
Until _____
PTR No. _____
IBP No. _____
TIN No. _____
Roll No. _____

(*For DSAS Personnel only*)

Attested by:

RODEL L. BALDADO, MHist, MAEd
OIC, Department of Student Affairs & Services
Date: 07/03/2026

APPENDIX A. Cont'd

MISAMIS UNVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02June2023

PARENT'S CONSENT

College of Medical Technology
Sponsoring Group/Organization

I am allowing my son/daughter/ward, Kirsten Levi V. Labastilla, to join the sample gathering phase of the research (activity) to be held on January to April 2026 at Misamis University under the supervision of Ms. Shaira Alaina M. Guiman (Adviser/Faculty).

I understand that Misamis University exercises the necessary safety precautions in this activity.

In consideration of the benefits to be derived from the above activity, I expressly waive any and all claims against the administration or any member of the faculty and staff of the Misamis University on account of any unforeseen accident or injury that my son/daughter/ward might incur in connection with the aforementioned activity.

Levi T. Labastilla
Signature over printed name of **Parent/Guardian**

01- 20 - 26
Date

Kirsten Levi V. Labastilla
Signature over printed name of **Student**

01- 20 - 26
Date

Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.

SUBSCRIBED AND SWORN to before me, this 12 day of [illegible] at Ozamiz City, Philippines, that the herein affiant personally came and appeared with his/her _____, as evidence of his/her personal identity.

Doc. No. 291
Page No. 58
Book No. 14
Series of 2026

ATTY. REY B. [illegible]
Notarial Commission No. 2025-18
Notary Public for Ozamiz City and Clarin
City Hall Drive, Barangay Subdivision, Aguada, Ozamiz City
PTR No. 6007751; 01/05/2026; Ozamiz City
IBP O.R. No. 576165; 12/26/2025; Pasig City
Attorney's Roll No. 70648
MCLE Compliance No. VIII-0014127; Valid until 04/14/2028

Notary Public
Until _____
PTR No. _____
IBP No. _____
TIN No. _____
Roll No. _____

(For DSAS Personnel only)

Attested by:

RODEL L. BALDADO, MHist, MAEd
OIC, Department of Student Affairs & Services

Date: _____

APPENDIX A. Cont'd

MISAMIS UNVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02June2023

PARENT'S CONSENT

Sponsoring Group/Organization

I am allowing my son/daughter/ward, Juliana Vannie B. Lacuata, to join the sample collection *(activity)* to be held on on the Month of Feb to March at Misc. Occ. under the supervision of Mr. Darwin R. Taylaran *(Adviser/Faculty)*.

I understand that Misamis University exercises the necessary safety precautions in this activity.

In consideration of the benefits to be derived from the above activity, I expressly waive any and all claims against the administration or any member of the faculty and staff of the Misamis University on account of any unforeseen accident or injury that my son/daughter/ward might incur in connection with the aforementioned activity.

GANDILYN S. BRIONES — Signature over printed name of **Parent/Guardian** — 01-18-26 — Date

JULIANA VANNIE B. LACUATA — Signature over printed name of **Student** — 01-18-26 — Date

Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.

SUBSCRIBED AND SWORN to before me, this 21 day of JAN 2026 at Ozamiz City, Philippines, that the herein affiant personally came and appeared with his/her _____, as evidence of his/her personal identity.

Doc. No. 262
Page No. 54
Book No. IX
Series of 2026

ATTY. REYES B. BIÑAG, RMT
Notarial Commission No. 2025-18
Notary Public for Ozamiz City and Clarin
City Hall Drive, Bernad Subdivision, Aguada, Ozamiz City
PTR No. 6007791; 01/05/2026; Ozamiz City
IBP O.R. No. 576165; 12/29/2025; Pasig City
Attorney's Roll No. 70648
MCLE Compliance No. VIII-0014127; Valid until 04/14/2028

Notary Public
Until _____
PTR No. _____
IBP No. _____
TIN No. _____
Roll No. _____

(For DSAS Personnel only)

Attested by:

RODEL L. BALDADO, MHist, MAEd
OIC, Department of Student Affairs & Services
Date: _____

APPENDIX A. Cont'd

MISAMIS UNVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02June2023

PARENT'S CONSENT

College of Medical Technology
Sponsoring Group/Organization

I am allowing my son/daughter/ward, Grace C. Lanas, to join the conduct of sample collection on research *(activity)* to be held on January to April 2026 at Misamis University under the supervision of Mr. Darwin R. Taylaran *(Adviser/Faculty)*.

I understand that Misamis University exercises the necessary safety precautions in this activity.

In consideration of the benefits to be derived from the above activity, I expressly waive any and all claims against the administration or any member of the faculty and staff of the Misamis University on account of any unforeseen accident or injury that my son/daughter/ward might incur in connection with the aforementioned activity.

Gloriosa C. Lanas
Signature over printed name of **Parent/Guardian**

Jan. 19, 2026
Date

Grace Lanas
Signature over printed name of **Student**

Jan. 19, 2026
Date

Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.

SUBSCRIBED AND SWORN to before me, this 20 day of JAN, 2026 at Ozamiz City, Philippines, that the herein affiant personally came and appeared with his/her _____, as evidence of his/her personal identity.

Doc. No. 288
Page No. 58
Book No. IV
Series of 2026

ATTY. [illegible] BALAG, JR.
Notarial Commission No. [illegible]
Notary Public for Ozamiz City and Clarin
City Hall Drive, Carmen Subdivision, Aguada, Ozamiz City
PTR No. 0007751; 01/05/2026; Ozamiz City
IBP O.R. No. 575199; 12/26/2025; Pasig City
Attorney's Roll No. 70648
MCLE Compliance No. VIII-0014127; Valid until 04/14/2028

Notary Public
Until _____
PTR No. _____
IBP No. _____
TIN No. _____
Roll No. _____

(For DSAS Personnel only)

Attested by:

RODEL L. BALDADO, MHist, MAEd
OIC, Department of Student Affairs & Services

Date: _____

APPENDIX A. Cont'd

MISAMIS UNVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02June2026

PARENT'S CONSENT

MU- College of Medical Technology
Sponsoring Group/Organization

I am allowing my son/daughter/ward, ELONEL JHAJE L. LLOBRERA, to join the simple gathering photo of the research study *(activity)* to be held on the Month of Feb to March at Misamis Occidental under the supervision of Mr. Dorwin R. Taylaran *(Adviser Faculty)*.

I understand that Misamis University exercises the necessary safety precautions in this activity.

In consideration of the benefits to be derived from the above activity, I expressly waive any and all claims against the administration or any member of the faculty and staff of the Misamis University on account of any unforeseen accident or injury that my son/daughter/ward might incur in connection with the aforementioned activity.

MARICA L. LLOBRERA
Signature over printed name of **Parent/Guardian**

7/8/2026
Date

ELONEL JHAJE L. LLOBRERA
Signature over printed name of **Student**

7/3/2026
Date

Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.

SUBSCRIBED AND SWORN to before me, this 03 JUL 2026 day of _____ at Ozamiz City, Philippines, that the herein affiant personally came and appeared with his/her _____, as evidence of his/her personal identity.

Doc. No. 96
Page No. 9
Book No. XIV
Series of 20 26

ATTY. REY B. BINAG, RMT
Notarial Commission No. 2025-18
Notary Public for Ozamiz City and Clarin
City Hall Drive, Bernad Subdivision, Aguada, Ozamiz City
PTR No. 6007751; 01/05/2026; Ozamiz City
IBP O.R. No. 576166; 12/29/2025; Pasig City
Attorney's Roll No. 70648
MCLE Compliance No. VIII-0014127; Valid until 04/14/2028

Notary Public
Until _____
PTR No. _____
IBP No. _____
TIN No. _____
Roll No. _____

(For DSAS Personnel only)

Attested by:

RODOLFO L. BALDADO, MHist, MAEd
OIC, Department of Student Affairs & Services
Date: 07/03/2026

APPENDIX A. Cont'd

MISAMIS UNVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02June2023

PARENT'S CONSENT

Research
Sponsoring Group/Organization

I am allowing my son/daughter/ward, Nichaela Honey S. Motus, to join the sample collection (*activity*) to be held on on the Month of Feb to March at Min. Occ. under the supervision of Mr. Darwin R. Taylaran (*Adviser/Faculty*).

I understand that Misamis University exercises the necessary safety precautions in this activity.

In consideration of the benefits to be derived from the above activity, I expressly waive any and all claims against the administration or any member of the faculty and staff of the Misamis University on account of any unforeseen accident or injury that my son/daughter/ward might incur in connection with the aforementioned activity.

Mark ... Motus Signature over printed name of **Parent/Guardian**	01/21/25 Date
Nichaela Honey S. Motus Signature over printed name of **Student**	01/21/25 Date

Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.

SUBSCRIBED AND SWORN to before me, this ____ day of 21 JAN 2025 at ________, Philippines, that the herein affiant personally came and appeared with his/her ________, as evidence of his/her personal identity.

ATTY. ROMUALDO LAPANO TORRES
Notary Public for Ozamiz City and Municipality of Clarin, Misamis Occidental

Doc. No. 111
Page No. 24
Book No. 4
Series of 20 25

____
Notary Public
Until ____________
PTR No.____________
IBP No.____________
TIN No.____________
Roll No.____________

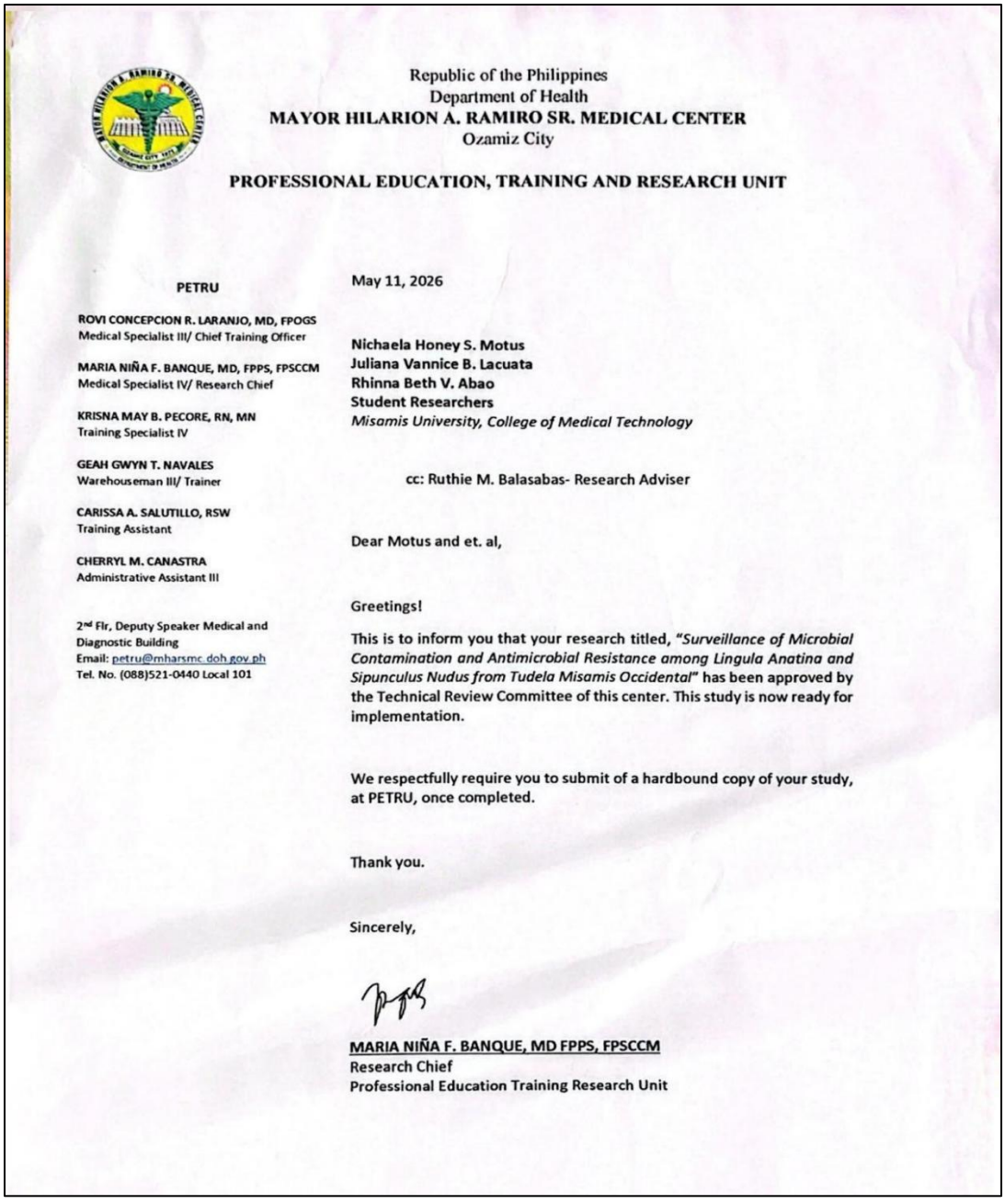
(*For DSAS Personnel only*)

Attested by:

RODEL L. BALDADO, MHist, MAEd
OIC, Department of Student Affairs & Services

Date: ________________

APPENDIX B. LETTERS OF CONSENT



Republic of the Philippines
Department of Health
MAYOR HILARION A. RAMIRO SR. MEDICAL CENTER
Ozamiz City

PROFESSIONAL EDUCATION, TRAINING AND RESEARCH UNIT

PETRU

ROVI CONCEPCION R. LARANJO, MD, FPOGS
Medical Specialist III/ Chief Training Officer

MARIA NIÑA F. BANQUE, MD, FPPS, FPSCCM
Medical Specialist IV/ Research Chief

KRISNA MAY B. PECORE, RN, MN
Training Specialist IV

GEAH GWYN T. NAVALES
Warehouseman III/ Trainer

CARISSA A. SALUTILLO, RSW
Training Assistant

CHERRYL M. CANASTRA
Administrative Assistant III

2nd Flr, Deputy Speaker Medical and Diagnostic Building
Email: petru@mharsmc.doh.gov.ph
Tel. No. (088)521-0440 Local 101

May 11, 2026

Nichaela Honey S. Motus
Juliana Vannice B. Lacuata
Rhinna Beth V. Abao
Student Researchers
Misamis University, College of Medical Technology

cc: Ruthie M. Balasabas- Research Adviser

Dear Motus and et. al,

Greetings!

This is to inform you that your research titled, "*Surveillance of Microbial Contamination and Antimicrobial Resistance among Lingula Anatina and Sipunculus Nudus from Tudela Misamis Occidental*" has been approved by the Technical Review Committee of this center. This study is now ready for implementation.

We respectfully require you to submit of a hardbound copy of your study, at PETRU, once completed.

Thank you.

Sincerely,

MARIA NIÑA F. BANQUE, MD FPPS, FPSCCM
Research Chief
Professional Education Training Research Unit

APPENDIX B. Cont'd

MISAMIS UNIVERSITY
Ozamiz City
COLLEGE OF MEDICAL TECHNOLOGY
CERTIFIED: ISO 21001: 2018 Educational Organizations Management System by DNV
ACCREDITED: Philippine Association of Colleges and Universities Commission on Accreditation (PACUCOA)

DR. HAYDEE D. VILLANUEVA, PhD
Dean, College of Arts and Sciences
Misamis University, Ozamis City

Warm greetings!

We, the student researchers from the College of Medical Technology of Misamis University, respectfully request permission to use the Natural Science Laboratory and to utilize the necessary laboratory equipment and reagents for our research entitled "Surveillance of Microbial Contamination and Antimicrobial Resistance among *Lingula anatina* and *Sipunculus nudus* from Tudela, Misamis Occidental."

The laboratory facilities, equipment, and reagents will be utilized for the preparation and processing of samples from the study, as well as for other microbiological procedures necessary to ensure accurate data collection and the completion of the research.

We assure you that all laboratory protocols and safety guidelines will be strictly observed, and that all materials will be handled responsibly and used appropriately.

Thank you for your consideration. We look forward to your favorable response.

APPENDIX B. Cont'd

MISAMIS UNIVERSITY
Ozamiz City
COLLEGE OF MEDICAL TECHNOLOGY
CERTIFIED: ISO 21001: 2018 Educational Organizations Management System by DNV
ACCREDITED: Philippine Association of Colleges and Universities Commission on Accreditation (PACUCOA)

Yours respectfully,

RESEARCHERS:

NICHAELA HONEY S. MOTUS
BS MedTech - 3

JULIANA VANNICE B. LACUATA
BS MedTech - 3

RHINNA BETH V. ABAO
BS MedTech - 3

NOTED BY:

DARWIN R. TAYLARAN, LPT
Research Adviser

ARJADE O. ALCABAZA, LPT, RChT
Laboratory-in-Charge of Natural Sciences

Recommending Approval:

NELFA D. CANINI, PhD
Chairperson, Department of Natural Sciences

Approved by:

HAYDEE D. VILLANUEVA, PhD
Dean, College of Arts and Sciences

APPENDIX B. Cont'd

MISAMIS UNIVERSITY
Ozamiz City
COLLEGE OF MEDICAL TECHNOLOGY
CERTIFIED: ISO 21001: 2018 Educational Organizations Management System by DNV
ACCREDITED: Philippine Association of Colleges and Universities Commission on Accreditation (PACUCOA)

Office of the Barangay Captain
Barangay Barra, Tudela
Misamis Occidental

Dear Captain Jimson C. Paquillan,

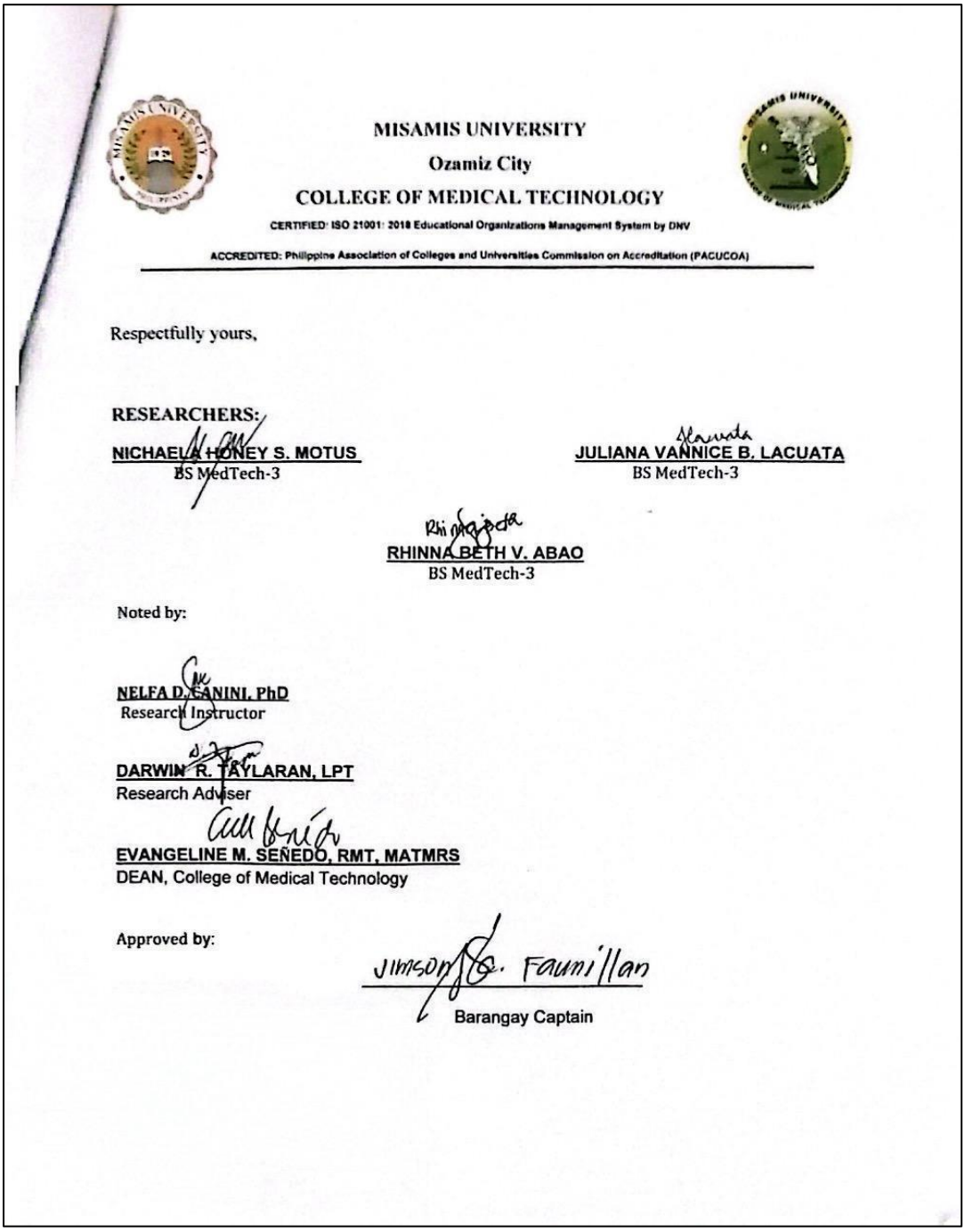
Warm Greetings!

We, the student researchers from the College of Medical Technology of Misamis University, respectfully request permission to conduct sample collection for our research entitled "Surveillance of Microbial Contamination and Antimicrobial Resistance among *Lingula anatina* and *Sipunculus nudus* from Tudela, Misamis Occidental." In line with this study, we are required to collect an adequate amount of specimen of *Lingula anatina* and *Sipinculus nudus* from the shoreline of Barangay Barra, which will be subjected to laboratory analysis as part of our research objectives.

In this regard, we respectfully seek your permission to collect samples within your barangay, which is under your jurisdiction. We assure you that the sampling activity will be conducted responsibly and in strict compliance with ethical research standards, environmental safety guidelines, and existing local regulations. Rest assured that this activity will not cause any damage to the environment nor disturb the community.

Thank you for your consideration. We look forward to your favorable response.

APPENDIX B. Cont'd



MISAMIS UNIVERSITY
Ozamiz City
COLLEGE OF MEDICAL TECHNOLOGY
CERTIFIED: ISO 21001: 2018 Educational Organizations Management System by DNV
ACCREDITED: Philippine Association of Colleges and Universities Commission on Accreditation (PACUCOA)

Respectfully yours,

RESEARCHERS:

NICHAELA HONEY S. MOTUS
BS MedTech-3

JULIANA VANNICE B. LACUATA
BS MedTech-3

RHINNA BETH V. ABAO
BS MedTech-3

Noted by:

NELFA D. CANINI, PhD
Research Instructor

DARWIN R. TAYLARAN, LPT
Research Adviser

EVANGELINE M. SEÑEDO, RMT, MATMRS
DEAN, College of Medical Technology

Approved by:

Jimson G. Faunillan
Barangay Captain

APPENDIX B. Cont'd

MISAMIS UNIVERSITY
Ozamiz City COLLEGE OF MEDICAL TECHNOLOGY
CERTIFIED: ISO 21001: 2018 Educational Organizations Management System by DNV
ACCREDITED: Philippine Association of Colleges and Universities Commission on Accreditation (PACUCOA)

April 13, 2026

EDWARD B. YASAY
Regional Director,
Bureau of Fisheries and Aquatic Resources, Region 10
Macaban, Cagayan de Oro City

Subject: Request for species identification for thesis

Dear Sir Yasay,

We, the undersigned 3rd-year Bachelor of Science in Medical Technology students from the College of Medical Technology, Misamis University, respectfully write to you regarding our research study entitled "Surveillance of microbial contamination and antimicrobial resistance in *Lingula Anatina* and *Sipunculus Nudus* from Barangay Barra, Tudela, Misamis Occidental."

The purpose of this letter is to formally request assistance in the species identification of *Lingula anatina and Sipunculus nudus* samples collected for our scientific study, as accurate identification is essential to the validity of our research.

This study was conducted solely for academic and research purposes, and all sample collection was carried out ethically and in accordance with established scientific standards.

Your favorable consideration of this request will be highly appreciated. Thank you very much.

Nicholas Motus - Medtech MU
09303857041
nicholas.motus@gmail.com

APPENDIX B. Cont'd

MISAMIS UNIVERSITY
Ozamiz City
COLLEGE OF MEDICAL TECHNOLOGY

Respectfully yours,

RESEARCHERS:

NICHAELA HONEY S. MOTUS
BS MedTech - 3

JULIANA VANNICE B. LACUATA
BS MedTech – 3

RHINNA BETH V. ABAO
BS MedTech - 3

Noted by:

NELFA D. CANINI, PhD
Research Instructor

DARWIN R. TAYLARAN, LPT
Research Adviser

EVANGELINE M. SEREDO, RMT, MATMRS
DEAN, College of Medical Technology

Approved by:

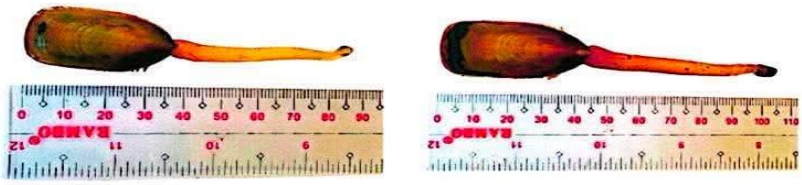
Regional Director, BFAR Region 10

APPENDIX B. Cont'd

Republic of the Philippines
Department of Agriculture
BUREAU OF FISHERIES AND AQUATIC RESOURCES - 10
Phone: (088) 856-9593
Macabalan, Cagayan de Oro City, Misamis Oriental 9000
Email: bfar10@bfar.da.gov.ph
Website: https://r10.bfar.da.gov.ph
Social Media: https://facebook.com/BFAR10
TIN No.: 000-550-823017

RESULTS OF ANALYSIS

Source of Specimen	: Brgy. Barra, Tudela, Misamis Occidental
Submitted by	: Nichaela Honey S. Motus et., al.
Address	: Misamis Occidental
Date Submitted	: April 16, 2026
Date of Completion of Analysis	: April 21, 2026
Examination	: Morphological Analysis
Kingdom	: Animalia
Phylum	: Brachiopoda
Class	: Lingulata
Order	: Lingulida
Family	: Lingulidae
Genus	: *Lingula*
Species	: *Lingula anatina* (Lamrack, 1801)



Sample 1. Specimen for morphological analysis of *Lingula anatina* (Lamrack, 1801)

Examination	: Morphological Analysis
Kingdom	: Animalia
Phylum	: Sipuncula
Class	: Sipunculidae
Order	: Sipunculiformes
Family	: Sipunculidae
Genus	: Sipunculus
Species	: *Sipunculus nudus* (Linnaeus, 1766)

Sample 2. Specimen for morphological analysis of *Lingula anatina* (Lamrack, 1801)

APPENDIX B. Cont'd

Republic of the Philippines
Department of Agriculture
BUREAU OF FISHERIES AND AQUATIC RESOURCES - 10
Phone: (088) 856-9593
Macabalan, Carayan de Oro City, Misamis Oriental 9000
Email: bfar10@bfar.da.gov.ph
Website: https: r10.bfar.da.gov.ph
Social Media: https: facebook.com.BFAR10
TIN No.: 000-550-823017

References:

Read, G., & Saiz-Salinas, J. (2026). *World Sipuncula Database. Sipunculus (Sipunculus) nudus* Linnaeus, 1766. World Register of Marine Species. https://www.marinespecies.org/aphia.php?p=taxdetails&id=136084

Rowell, A. J. (1964). *Lingula* Bruguière (1797) (Brachiopoda: Inarticulata): Proposed designation of a type-species under the plenary powers. Z.N. (S), 1958. *Bulletin of Zoological Nomenclature, 21*, 222–224. https://doi.org/10.5962/bhl.part.28493

Integrated Taxonomic Information System. (n.d.). *Sipunculus nudus* Linnaeus, 1766 (TSN 154523). Retrieved April 22, 2026, from https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=154523

Integrated Taxonomic Information System. (n.d.). *Taxonomic Serial Number (TSN) 156763*. Retrieved April 22, 2026, from https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=156763

APPENDIX B.Cont'd

Republic of the Philippines
Department of Agriculture
BUREAU OF FISHERIES AND AQUATIC RESOURCES - 10
Phone: (088) 856-9593
Macabalan, Cagayan de Oro City, Misamis Oriental 9000
Email: bfar10@bfar.da.gov.ph
Website: https://r10.bfar.da.gov.ph
Social Media: https://facebook.com/BFAR10
TIN No.: 000-550-823017

CERTIFICATION

This is to certify that the samples submitted by **NICHAELA HONEY S. MOTUS** and received by **BFAR-10** on **April 16, 2026**, were subjected to morphological analysis and were identified as the following scientifically recognized species:

1. *Lingula anatina* (Lamrack, 1801)
2. *Sipunculus nudus* (Linnaeus, 1766)

This certification is issued on the **21st** of **April 2026** at BFAR Regional Office, Cagayan de Oro City.

Certified by:

PRINCESS MAE T. CENA
Marine Biologist/PARLC Member

MARC NICHOLE B. AUGUSTO
Registered Fisheries Professional

Attested by:

ATTY. ROLAND B. INTUD
OIC, FMRED

Approved:

EDWARD B. YASAY
Regional Director

APPENDIX B.Cont'd

Department of Agriculture
BUREAU OF FISHERIES AND AQUATIC RESOURCES 10
PROVINCIAL FISHERIES OFFICE-MISAMIS OCCIDENTAL
City Hall Compound, Aguada, Ozamiz City, Misamis Occidental
Phone: +63 (088) 856-9593 | +63 (088) 564-0690
E-mail: bfar10@bfar.da.gov.ph | pfomisocc10@bfar.da.gov.ph
Website: https://region10.bfar.da.gov.ph/
Social Media: https://www.facebook.com/BFAR10?mibextid=JRoKGI
TIN No.: 000-550-823-017

April 15, 2026

FOR : **EDWARD B. YASAY**
Regional Director

FROM : **FELIX L. MEJOS**
OIC, PFO Misamis Occidental

SUBJECT : **SUBMISSION OF REQUEST FOR SPECIES VERIFICATION FROM MISAMIS UNIVERSITY**

Respectfully submitted and endorsed herewith is the request from the students of **Misamis University – Medical Technology Department** for the **species verification** of the following samples in support of their research studies:

1. **Canarium urceus (Aninikad)** – for the research entitled: *"Microbial Assessment of Foodborne Bacteria in Canarium urceus (Aninikad) from Wet Markets of Misamis Occidental."*
2. **Lingula anatina** and **Sipunculus nudus** – for the research entitled: *"Surveillance of Microbial Contamination and Antimicrobial Resistance."*

The requested species verification is necessary to ensure accurate identification of samples used in their research requirement and documentation.

Attached herewith is the students' request letter for your reference and appropriate action.

ACTION REQUESTED: For information and approval

FELIX L. MEJOS
OIC, PFO Misamis Occidental

RL 2026 04 09 92 PFO MOC

Masaganang Agrikultura, Maunlad na Ekonomiya

APPENDIX C. STATISTICAL COMPUTATIONS

	A1 TCBS SID5-1	A1 TCBS D5-1	A2 TCBS-1	A3 TCBS-1	MEAN
AMPICILLIN	32	32	32	32	32
AMOXICILLIN/CLAVULANIC ACID	2	2	4	2	2.5
AMPICILLIN/SULBACTAM	2	2	4	2	2.5
PIPERACILLIN/TAZOBACTAM	4	4	4	4	4
CEFUROXIME	16	16	16	16	16
CEFUROXIME AXETIL					
CEFOXITIN	8	4	16	8	9
CEFOTAXIME	0.25	0.25	0.25	0.25	0.25
CEFTAZIDIME	0.5	0.12	0.5	0.5	0.41
CEFEPIME	0.12	0.12	0.12	0.12	0.12
ERTAPENEM					
MEROPENEM	0.25	0.25	0.25	0.25	0.25
AMIKACIN	8	8	8	4	7
GENTAMICIN	1	1	1	1	1
CIPROFLOXACIN	0.12	0.12	0.12	0.12	0.12
LEVOFLOXACIN	0.12	0.12	0.12	0.12	0.12
TRIMETHOPRIM/SULFAMETHOXAZOLE	20	20	20	20	20

APPENDIX C. Cont'd

	A1 EMB-1	MEAN
AMPICILLIN	32	32
AMOXICILLIN/CLAVULANIC ACID	2	2
AMPICILLIN/SULBACTAM	4	4
PIPERACILLIN/TAZOBACTAM	4	4
CEFUROXIME	2	2
CEFUROXIME AXETIL	2	2
CEFOXITIN	4	4
CEFOTAXIME	0.25	0.25
CEFTAZIDIME	0.12	0.12
CEFEPIME	0.12	0.12
ERTAPENEM	0.12	0.12
MEROPENEM	0.25	0.25
AMIKACIN	1	1
GENTAMICIN	1	1
CIPROFLOXACIN	0.06	0.06
LEVOFLOXACIN	0.12	0.12
TRIMETHOPRIM/SULFAMETHOXAZOLE	20	20

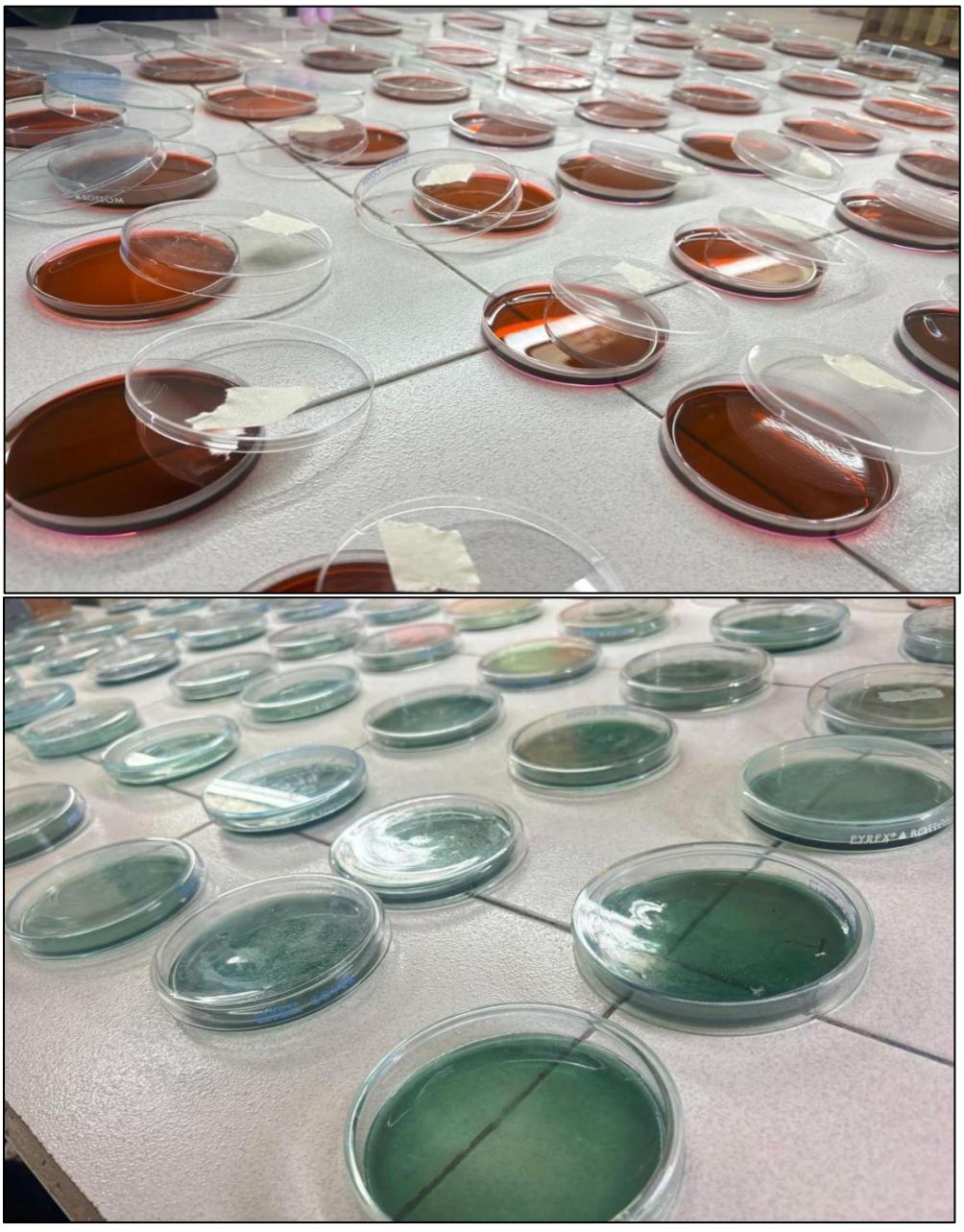
APPENDIX C. Cont'd

	A1 TCBS-1	A2 TCBS-1	A2 SID4-1	MEAN
AMPICILLIN	32	32	32	32
AMOXICILLIN/CLAVULANIC ACID	2	2	2	2
AMPICILLIN/SULBACTAM	2	2	2	2
PIPERACILLIN/TAZOBACTAM	4	4	4	4
CEFUROXIME	16	16	16	16
CEFUROXIME AXETIL				
CEFOXITIN	8	4	16	9.33
CEFOTAXIME	0.25	0.25	0.25	0.25
CEFTAZIDIME	0.5	0.5	1	0.67
CEFEPIME	0.25	0.25	0.12	0.21
ERTAPENEM				
MEROPENEM	0.25	0.25	0.25	0.25
AMIKACIN	16	16	4	12
GENTAMICIN	1	1	1	1
CIPROFLOXACIN	0.12	0.12	0.06	0.1
LEVOFLOXACIN	0.12	0.12	0.12	0.12
TRIMETHOPRIM/SULFAMETHOXAZOLE	20	20	20	20

APPENDIX D. DOCUMENTATION

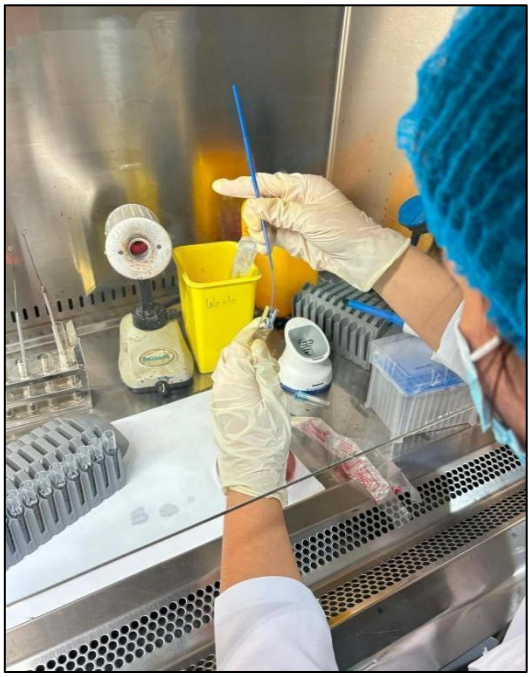
APPENDIX D. Cont'd

APPENDIX D. Cont'd



APPENDIX D. Cont'd

APPENDIX D. Cont'd



APPENDIX D. Cont'd

APPENDIX D. Cont'd

MHARS Medical Center
Laboratory Report

bioMérieux Customer:
System #:
Isolate: A3, LA, EMB-1 (To be reviewed)
Card Type: GN Bar Code: 2413249603213500 Testing Instrument: 00001FB98EBB (27958)
Card Type: AST-N449 Bar Code: 0913401104404299 Testing Instrument: 00001FB98EBB (27958)
Setup Technologist: Laboratory Administrator(Labadmin)

Printed by: Labadmin
Bench: JOHN CARLO B BONGALES,RMT

Bionumber: 2607774653564610
Organism Quantity:

Selected Organism: Klebsiella pneumoniae ssp pneumoniae

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	4.83 hours	**Completed:**	May 20, 2026 22:22 CST
Organism Origin	VITEK 2					
Selected Organism	92% Probability		**Klebsiella pneumoniae ssp pneumoniae**			
	Bionumber: 2607774653564610			Confidence: Good identification		
Analysis Organisms and Tests to Separate:						
Analysis Messages:						
Contraindicating Typical Biopattern(s)						
Klebsiella pneumoniae ssp pneumoniae	BAlap(1),BGUR(3),					

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	17.55 hours	**Completed:**	May 21, 2026 11:06 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	<= 0.12	S
Amoxicillin/Clavulanic Acid	<= 2	S	Ertapenem	<= 0.12	S
Ampicillin/Sulbactam	>= 32	R	Meropenem	8	R
Piperacillin/Tazobactam	<= 4	S	Amikacin	<= 1	S
Cefuroxime	16	I	Gentamicin	<= 1	S
Cefuroxime Axetil	16	I	Ciprofloxacin	<= 0.06	S
Cefoxitin	<= 4	S	Levofloxacin	1	I
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	<= 0.12	S			

AES Findings:	**Last Modified:**	Jan 27, 2026 10:55 CST	**Parameter Set:**	Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Inconsistent			

Installed VITEK 2 Systems Version: 9.04.4
MIC Interpretation Guideline: Global CLSI-based (2025)
Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)
AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)
AES Parameter Last Modified: Jan 27, 2026 10:55 CST
Page 1 of 2

APPENDIX D. Cont'd

MHARS Medical Center

Laboratory Report

bioMérieux Customer:
System #:
Isolate: A2, LA, S1D4-1 (To be reviewed)
Card Type: GN Bar Code: 2413249603210631 Testing Instrument: 00001FB98EBB (27958)
Card Type: AST-N449 Bar Code: 0913401104404290 Testing Instrument: 00001FB98EBB (27958)
Setup Technologist: Laboratory Administrator(Labadmin)

Printed by: Labadmin
Bench: JOHN CARLO B BONGALES,RMT

Bionumber: 5021611040500262
Organism Quantity:

Selected Organism: Vibrio parahaemolyticus

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	5.80 hours	**Completed:**	May 20, 2026 23:42 CST
Organism Origin	VITEK 2					
Selected Organism	99% Probability		**Vibrio parahaemolyticus**			
	Bionumber: 5021611040500262			Confidence: Excellent identification		
Analysis Organisms and Tests to Separate:						
Analysis Messages: The following antibiotic(s) are not claimed: Ertapenem,						
Contraindicating Typical Biopattern(s)						

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	13.62 hours	**Completed:**	May 21, 2026 07:32 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	0.25	S
Amoxicillin/Clavulanic Acid	<= 2	S	Ertapenem		
Ampicillin/Sulbactam	<= 2	S	Meropenem	<= 0.25	S
Piperacillin/Tazobactam	<= 4	S	Amikacin	16	S
Cefuroxime	16	I	Gentamicin	<= 1	S
Cefuroxime Axetil			Ciprofloxacin	0.12	S
Cefoxitin	<= 4	S	Levofloxacin	<= 0.12	S
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	0.5	S			

AES Findings:	**Last Modified:** Jan 27, 2026 10:55 CST **Parameter Set:** Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Analysis not performed

Installed VITEK 2 Systems Version: 9.04.4
MIC Interpretation Guideline: Global CLSI-based (2025)
Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)
AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)
AES Parameter Last Modified: Jan 27, 2026 10:55 CST

Page 1 of 2

MHARS Medical Center
Laboratory Report

bioMérieux Customer:
System #:
Isolate: A1, PW, TCBS D5-1 (To be reviewed)
Printed by: Labadmin
Bench: JOHN CARLO B BONGALES,RMT
Card Type: GN Bar Code: 2413249603210923 Testing Instrument: 00001FB98EBB (27958)
Card Type: AST-N449 Bar Code: 0913401104404297 Testing Instrument: 00001FB98EBB (27958)
Setup Technologist: Laboratory Administrator(Labadmin)

Bionumber: 1021611440000220
Organism Quantity:
Selected Organism: Vibrio parahaemolyticus

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	5.10 hours	**Completed:**	May 20, 2026 22:39 CST
Organism Origin	VITEK 2					
Selected Organism	99% Probability		**Vibrio parahaemolyticus**			
	Bionumber: 1021611440000220			Confidence: Excellent identification		
Analysis Organisms and Tests to Separate:						
Analysis Messages: The following antibiotic(s) are not claimed: Ertapenem,						
Contraindicating Typical Biopattern(s)						

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	11.93 hours	**Completed:**	May 21, 2026 05:29 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	<= 0.12	S
Amoxicillin/Clavulanic Acid	<= 2	S	Ertapenem		
Ampicillin/Sulbactam	<= 2	S	Meropenem	<= 0.25	S
Piperacillin/Tazobactam	<= 4	S	Amikacin	8	S
Cefuroxime	16	I	Gentamicin	<= 1	S
Cefuroxime Axetil			Ciprofloxacin	0.12	S
Cefoxitin	<= 4	S	Levofloxacin	<= 0.12	S
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	<= 0.12	S			

AES Findings:	**Last Modified:**	Jan 27, 2026 10:55 CST	**Parameter Set:**	Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Analysis not performed			

Installed VITEK 2 Systems Version: 9.04.4
MIC Interpretation Guideline: Global CLSI-based (2025)
Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)
AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)
AES Parameter Last Modified: Jan 27, 2026 10:55 CST
Page 1 of 2

APPENDIX D. Cont'd

MHARS Medical Center

bioMérieux Customer:

Laboratory Report

System #:

Printed by: Labadmin

Isolate: A2, LA, EMB-1 (To be reviewed)

Bench: JOHN CARLO B BONGALES,RMT

Card Type: GN Bar Code: 2413249603213503 Testing Instrument: 00001FB98EBB (27958)

Card Type: AST-N449 Bar Code: 0913401104404301 Testing Instrument: 00001FB98EBB (27958)

Setup Technologist: Laboratory Administrator(Labadmin)

Bionumber: 2607774653064600

Organism Quantity:

Selected Organism: Klebsiella pneumoniae ssp pneumoniae

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	4.05 hours	**Completed:**	May 20, 2026 21:23 CST
Organism Origin	VITEK 2					
Selected Organism	92% Probability		**Klebsiella pneumoniae ssp pneumoniae**			
	Bionumber: 2607774653064600		Confidence: Good identification			
Analysis Organisms and Tests to Separate:						
Analysis Messages:						
Contraindicating Typical Biopattern(s)						
Klebsiella pneumoniae ssp pneumoniae	BAlap(1),BGUR(3),					

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	17.72 hours	**Completed:**	May 21, 2026 11:03 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	<= 0.12	S
Amoxicillin/Clavulanic Acid	<= 2	S	Ertapenem	<= 0.12	S
Ampicillin/Sulbactam	>= 32	R	Meropenem	8	R
Piperacillin/Tazobactam	<= 4	S	Amikacin	<= 1	S
Cefuroxime	32	R	Gentamicin	<= 1	S
Cefuroxime Axetil	32	R	Ciprofloxacin	<= 0.06	S
Cefoxitin	<= 4	S	Levofloxacin	<= 0.12	S
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	4	S			

AES Findings:	**Last Modified:** Jan 27, 2026 10:55 CST	**Parameter Set:**	Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Inconsistent		

Installed VITEK 2 Systems Version: 9.04.4

MIC Interpretation Guideline: Global CLSI-based (2025)

Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)

AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)

AES Parameter Last Modified: Jan 27, 2026 10:55 CST

Page 1 of 2

APPENDIX D. Cont'd

MHARS Medical Center

bioMérieux Customer:

Laboratory Report

System #:

Printed by: Labadmin

Isolate: A2, PW, TCBS-1 (To be reviewed)

Bench: JOHN CARLO B BONGALES,RMT

Card Type: GN Bar Code: 2413249603210921 Testing Instrument: 00001FB98EBB (27958)

Card Type: AST-N449 Bar Code: 0913401104404295 Testing Instrument: 00001FB98EBB (27958)

Setup Technologist: Laboratory Administrator(Labadmin)

Bionumber: 1031611050040220

Organism Quantity:

Selected Organism: Vibrio alginolyticus

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	5.85 hours	**Completed:**	May 20, 2026 23:25 CST
Organism Origin	VITEK 2					
Selected Organism	95% Probability		**Vibrio alginolyticus**			
	Bionumber: 1031611050040220			Confidence: Very good identification		
Analysis Organisms and Tests to Separate:						
Analysis Messages: The following antibiotic(s) are not claimed: Ertapenem,						
Contraindicating Typical Biopattern(s) Vibrio alginolyticus H2S(1),						

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	12.68 hours	**Completed:**	May 21, 2026 06:15 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	<= 0.12	S
Amoxicillin/Clavulanic Acid	4	S	Ertapenem		
Ampicillin/Sulbactam	4	S	Meropenem	<= 0.25	S
Piperacillin/Tazobactam	<= 4	S	Amikacin	8	S
Cefuroxime	16	I	Gentamicin	<= 1	S
Cefuroxime Axetil			Ciprofloxacin	0.12	S
Cefoxitin	16	I	Levofloxacin	<= 0.12	S
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	0.5	S			

AES Findings:	**Last Modified:** Jan 27, 2026 10:55 CST **Parameter Set:** Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Analysis not performed

Installed VITEK 2 Systems Version: 9.04.4

MIC Interpretation Guideline: Global CLSI-based (2025)

Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)

AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)

AES Parameter Last Modified: Jan 27, 2026 10:55 CST

Page 1 of 2

APPENDIX D. Cont'd

MHARS Medical Center

Laboratory Report

bioMérieux Customer:
System #:
Printed by: Labadmin
Isolate: A3, PW, TCBS-1 (To be reviewed)
Bench: JOHN CARLO B BONGALES,RMT
Card Type: GN Bar Code: 2413249603210919 Testing Instrument: 00001FB98EBB (27958)
Card Type: AST-N449 Bar Code: 0913401104404293 Testing Instrument: 00001FB98EBB (27958)
Setup Technologist: Laboratory Administrator(Labadmin)

Bionumber: 5021611040500262
Organism Quantity:

Selected Organism: Vibrio parahaemolyticus

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	5.78 hours	**Completed:**	May 20, 2026 23:41 CST
Organism Origin	VITEK 2					
Selected Organism	99% Probability **Vibrio parahaemolyticus**					
	Bionumber: 5021611040500262			Confidence: Excellent identification		
Analysis Organisms and Tests to Separate:						
Analysis Messages: The following antibiotic(s) are not claimed: Ertapenem,						
Contraindicating Typical Biopattern(s)						

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	8.95 hours	**Completed:**	May 21, 2026 02:51 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	<= 0.12	S
Amoxicillin/Clavulanic Acid	<= 2	S	Ertapenem		
Ampicillin/Sulbactam	<= 2	S	Meropenem	<= 0.25	S
Piperacillin/Tazobactam	<= 4	S	Amikacin	4	S
Cefuroxime	16	I	Gentamicin	<= 1	S
Cefuroxime Axetil			Ciprofloxacin	0.12	S
Cefoxitin	8	S	Levofloxacin	<= 0.12	S
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	0.5	S			

AES Findings:	**Last Modified:** Jan 27, 2026 10:55 CST	**Parameter Set:**	Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Analysis not performed		

Installed VITEK 2 Systems Version: 9.04.4
MIC Interpretation Guideline: Global CLSI-based (2025)
Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)
AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)
AES Parameter Last Modified: Jan 27, 2026 10:55 CST

Page 1 of 2

APPENDIX D. Cont'd

MHARS Medical Center

Laboratory Report

bioMérieux Customer:
System #:
Isolate: A1, LA, TCBS-1 (To be reviewed)
Card Type: GN Bar Code: 2413249603213499 Testing Instrument: 00001FB98EBB (27958)
Card Type: AST-N449 Bar Code: 0913401104404298 Testing Instrument: 00001FB98EBB (27958)
Setup Technologist: Laboratory Administrator(Labadmin)

Printed by: Labadmin
Bench: JOHN CARLO B BONGALES,RMT

Bionumber: 5025611140504262
Organism Quantity:

Selected Organism: Vibrio parahaemolyticus

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	5.82 hours	**Completed:**	May 20, 2026 23:22 CST
Organism Origin	VITEK 2					
Selected Organism	96% Probability **Vibrio parahaemolyticus**					
	Bionumber: 5025611140504262 Confidence: Excellent identification					
Analysis Organisms and Tests to Separate:						
Analysis Messages: The following antibiotic(s) are not claimed: Ertapenem,						
Contraindicating Typical Biopattern(s) Vibrio parahaemolyticus LDC(3),						

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	16.82 hours	**Completed:**	May 21, 2026 10:22 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	0.25	S
Amoxicillin/Clavulanic Acid	<= 2	S	Ertapenem		
Ampicillin/Sulbactam	<= 2	S	Meropenem	<= 0.25	S
Piperacillin/Tazobactam	<= 4	S	Amikacin	16	S
Cefuroxime	16	I	Gentamicin	<= 1	S
Cefuroxime Axetil			Ciprofloxacin	0.12	S
Cefoxitin	8	S	Levofloxacin	<= 0.12	S
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	0.5	S			

AES Findings:	**Last Modified:** Jan 27, 2026 10:55 CST	**Parameter Set:**	Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Analysis not performed		

Installed VITEK 2 Systems Version: 9.04.4
MIC Interpretation Guideline: Global CLSI-based (2025)
Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)
AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)
AES Parameter Last Modified: Jan 27, 2026 10:55 CST

Page 1 of 2

APPENDIX D. Cont'd

MHARS Medical Center

bioMérieux Customer:

Laboratory Report

System #:

Printed by: Labadmin

Isolate: A1, PW, TCBS S1D5-1 (To be reviewed)

Bench: JOHN CARLO B BONGALES,RMT

Card Type: GN Bar Code: 2413249603210632 Testing Instrument: 00001FB98EBB (27958)

Card Type: AST-N449 Bar Code: 0913401104404291 Testing Instrument: 00001FB98EBB (27958)

Setup Technologist: Laboratory Administrator(Labadmin)

Bionumber: 0225611440000202

Organism Quantity:

Selected Organism: Vibrio parahaemolyticus

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	6.02 hours	**Completed:**	May 20, 2026 23:54 CST
Organism Origin	VITEK 2					
Selected Organism	95% Probability **Vibrio parahaemolyticus**					
	Bionumber: 0225611440000202 Confidence: Very good identification					
Analysis Organisms and Tests to Separate:						
Analysis Messages: The following antibiotic(s) are not claimed: Ertapenem,						
Contraindicating Typical Biopattern(s) Vibrio parahaemolyticus GGAA(98),						

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	10.65 hours	**Completed:**	May 21, 2026 04:32 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	<= 0.12	S
Amoxicillin/Clavulanic Acid	<= 2	S	Ertapenem		
Ampicillin/Sulbactam	<= 2	S	Meropenem	<= 0.25	S
Piperacillin/Tazobactam	<= 4	S	Amikacin	8	S
Cefuroxime	16	I	Gentamicin	<= 1	S
Cefuroxime Axetil			Ciprofloxacin	0.12	S
Cefoxitin	8	S	Levofloxacin	<= 0.12	S
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	0.5	S			

AES Findings:	**Last Modified:** Jan 27, 2026 10:55 CST	**Parameter Set:**	Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Analysis not performed		

Installed VITEK 2 Systems Version: 9.04.4

MIC Interpretation Guideline: Global CLSI-based (2025)

Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)

AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)

AES Parameter Last Modified: Jan 27, 2026 10:55 CST

Page 1 of 2

APPENDIX D. Cont'd

MHARS Medical Center

bioMérieux Customer:

Laboratory Report

System #:

Printed by: Labadmin

Isolate: A2, LA, TCBS-1 (To be reviewed)

Bench: JOHN CARLO B BONGALES,RMT

Card Type: GN Bar Code: 2413249603210922 Testing Instrument: 00001FB98EBB (27958)

Card Type: AST-N449 Bar Code: 0913401104404296 Testing Instrument: 00001FB98EBB (27958)

Setup Technologist: Laboratory Administrator(Labadmin)

Bionumber: 0025611440000220

Organism Quantity:

Selected Organism: Vibrio parahaemolyticus

Comments:	

McFarland:

Identification Information	**Card:**	GN	**Lot Number:**	2413249603	**Expires:**	Oct 19, 2026 12:00 CST
	Status:	Final	**Analysis Time:**	4.87 hours	**Completed:**	May 20, 2026 22:26 CST
Organism Origin	VITEK 2					
Selected Organism	99% Probability **Vibrio parahaemolyticus**					
	Bionumber: 0025611440000220				Confidence: Excellent identification	
Analysis Organisms and Tests to Separate:						
Analysis Messages: The following antibiotic(s) are not claimed: Ertapenem,						
Contraindicating Typical Biopattern(s)						

McFarland:

Susceptibility Information	**Card:**	AST-N449	**Lot Number:**	0913401104	**Expires:**	Mar 20, 2027 12:00 CST
	Status:	Final	**Analysis Time:**	15.37 hours	**Completed:**	May 21, 2026 08:56 CST

Antimicrobial	MIC	Interpretation	Antimicrobial	MIC	Interpretation
Ampicillin	>= 32	R	Cefepime	<= 0.12	S
Amoxicillin/Clavulanic Acid	<= 2	S	Ertapenem		
Ampicillin/Sulbactam	<= 2	S	Meropenem	<= 0.25	S
Piperacillin/Tazobactam	<= 4	S	Amikacin	4	S
Cefuroxime	16	I	Gentamicin	<= 1	S
Cefuroxime Axetil			Ciprofloxacin	<= 0.06	S
Cefoxitin	16	I	Levofloxacin	<= 0.12	S
Cefotaxime	<= 0.25	S	Trimethoprim/ Sulfamethoxazole	<= 20	S
Ceftazidime	1	S			

AES Findings:	**Last Modified:** Jan 27, 2026 10:55 CST	**Parameter Set:** Global CLSI-based+Natural Resistance (2025)
Confidence Level:	Analysis not performed	

Installed VITEK 2 Systems Version: 9.04.4

MIC Interpretation Guideline: Global CLSI-based (2025)

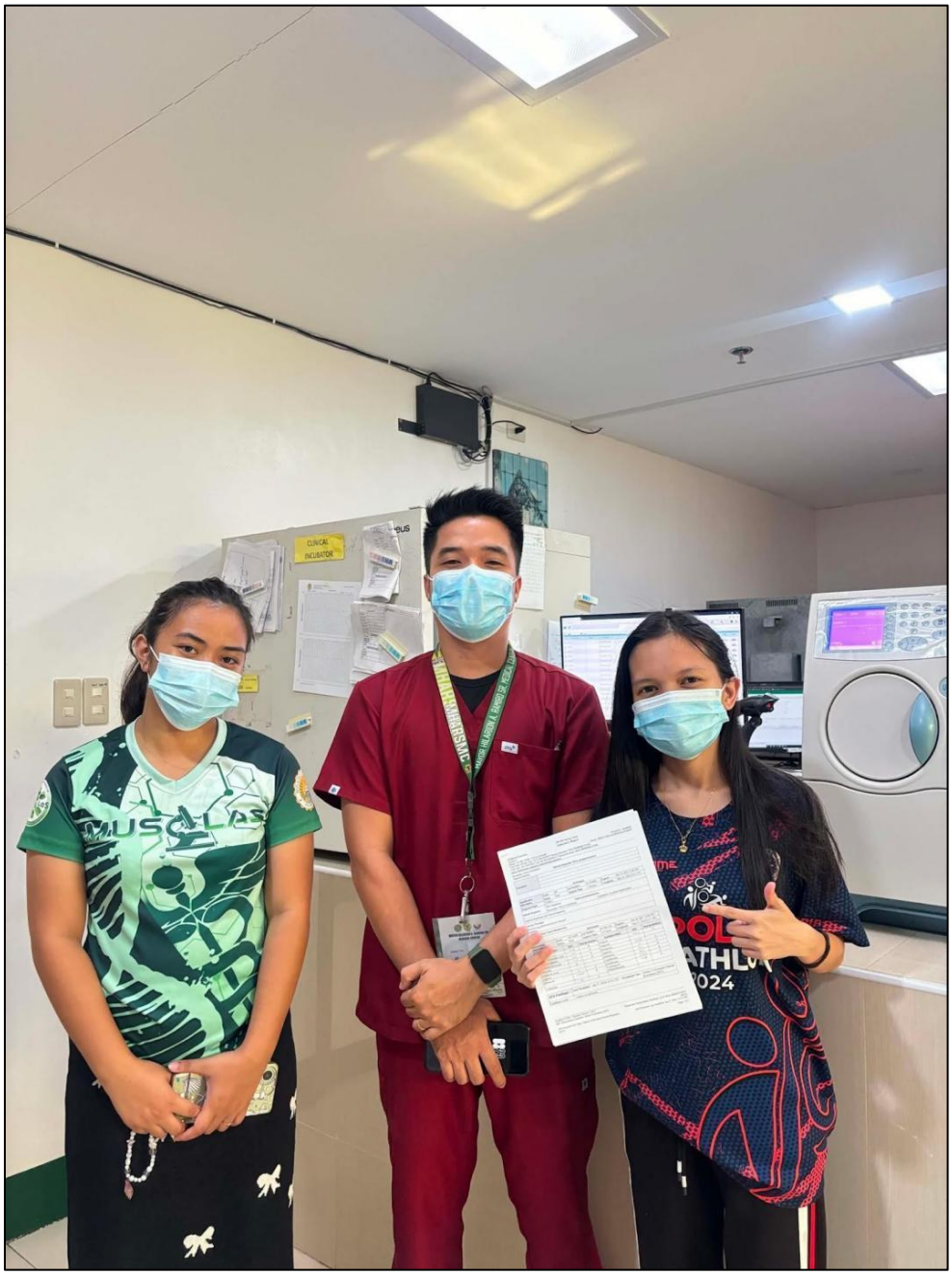
Therapeutic Interpretation Guideline: NATURAL RESISTANCE (2025)

AES Parameter Set Name: Global CLSI-based+Natural Resistance (2025)

AES Parameter Last Modified: Jan 27, 2026 10:55 CST

Page 1 of 2

APPENDIX D. Cont'd



APPENDIX D. Cont'd

APPENDIX E. Turnitin Result and Grammarly Report

turnitin Page 2 of 74 - Integrity Overview Submission ID trn:oid:::28647:146078665

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APPENDIX E. Cont'd

MICROBIAL IDENTIFICATION AND ANTIMICROBIAL RESISTANCE OF MICROORGANISMS PRESENT IN LAMP SHELL (Lingula anatina Lamarck, 1801) AND PEANUT WORM (Sipunculus nudus Linnaeus, 1766) SEAFOOD SAMPLES AT BARRA, TUDELA, MISAMIS OCCIDENTAL

by Misamis University

General metrics

52,873	6,989	396	27 min 57 sec	53 min 45 sec
characters	words	sentences	reading time	speaking time

Score

99

This text scores better than 99% of all texts checked by Grammarly

Writing Issues

33	16	17
Issues left	Critical	Advanced

Plagiarism

This text hasn't been checked for plagiarism

CURRICULUM VITAE

PERSONAL INFORMATION

Name: Rhinna Beth V. Abao

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2008 – 2017

CURRICULUM VITAE

PERSONAL INFORMATION

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2007 - 2016

CURRICULUM VITAE

PERSONAL INFORMATION

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Purok 3, Pan-ay Clarin Misamis Occidental

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CURRICULUM VITAE

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CURRICULUM VITAE

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Mayor Fernando Bernad Ave, Lam-an, Ozamiz City

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Primary education: Fernandez-Zacal Learning Center

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2008 - 2017

CURRICULUM VITAE

PERSONAL INFORMATION

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2017 - 2023

Primary education: St. Nicholas School of Plaridel Inc.

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2008- 2017