

**DETECTION OF FOODBORNE BACTERIA IN COMMERCIALY
SOLD ANINIKAD (*Canarium urceus*) IN TUDELA,
MISAMIS OCCIDENTAL**

A RESEARCH PAPER

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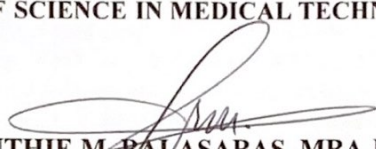


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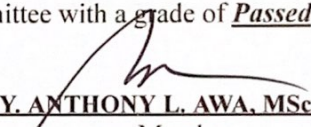
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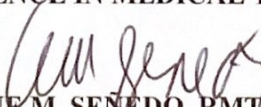

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ABSTRACT

Foodborne pathogens in seafood remain a significant public health concern, particularly in marine gastropods that may accumulate microorganisms from contaminated coastal environments. This study assessed the microbiological quality of commercially sold aninikad (*Canarium urceus*) obtained from Tudela, Misamis Occidental by determining the presence and contamination levels of *Vibrio* spp. and *Salmonella* spp. A descriptive, cross-sectional research design was employed. Soft tissues from the collected samples were processed and analyzed using standard microbiological procedures in accordance with the U.S. Food and Drug Administration Bacteriological Analytical Manual. *Vibrio* spp. were isolated using Alkaline Peptone Water and Thiosulfate-Citrate-Bile Salts-Sucrose agar. In contrast, *Salmonella* spp. were analyzed using Buffered Peptone Water, Rappaport-Vassiliadis broth, and Salmonella-Shigella agar. Colony counts were expressed as colony-forming units per gram (CFU/g) and converted to $\log_{10}$ CFU/g values to evaluate contamination risk. Results showed the presence of *Vibrio* spp., with *V. cholerae* identified as the predominant species, while *V. parahaemolyticus* and *Salmonella* spp. were not detected. The bacterial load of *V. cholerae* had a mean concentration of 1.02×10^7 CFU/g, corresponding to $7.009 \pm 0.005 \log_{10}$ CFU/g. This level exceeded the established threshold for *Vibrio* spp. and indicated a medium-to-high risk of contamination. The findings demonstrate that commercially sold *C. urceus* from Tudela may harbor potentially pathogenic *Vibrio* species and highlight the importance of proper handling, cooking, and routine microbial monitoring to ensure seafood safety and protect public health.

Keywords: *Canarium urceus*, foodborne pathogens, food safety, microbial contamination, public health

This research paper is sincerely dedicated to the following:

To our Almighty God, whose faithful love, unending grace, and unmatched faithfulness guided us through every difficulty and uncertainty. To our families whose sacrifices, love, and support have been the cornerstone of our journey. To our instructors, who have patiently given their effort, time, knowledge, and wisdom, helping shape not only our academic development but also our character. Lastly, to the citizens of Tudela, Misamis Occidental and the neighboring municipalities, whose well-being inspired the very heart of this research. It is through our concern that we found the purpose and motivation to pursue this study, hoping that, in some way, our work may contribute to the betterment, safety, and security of our community.

- Aubrey, John Paul, Kassandra, Xylliengen

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INTRODUCTION

Background of the Study

Among the pressing global issues, food safety remains an urgent concern. The World Health Organization (2024) estimates that around 600 million people, close to 10% of the world's population, suffer from foodborne illnesses annually, resulting in about 420,000 deaths. This problem has huge impacts on developing countries, leading to 125,000 deaths among children below five years of age. These diseases can range from minor gastrointestinal symptoms to serious, life-threatening complications like kidney or liver failure and neurological abnormalities, which stem from various microorganisms, such as bacteria, viruses, and parasites (CDC, 2025).

The globalization of complex food chains, which increases food safety risks such as bacterial contamination, chemical pollutants from pesticides, heavy metals, and improper food handling, facilitates the spread of pathogens (Tibebu, 2024; Brauge et al., 2024). Among the enteric bacteria commonly linked to contaminated food and recognized as major agents of outbreaks worldwide are *Vibrio* spp. and *Salmonella* spp. (Brauge et al., 2024; Ghosh, 2021). Mollusks are rich in vitamins, minerals, and omega-3 fatty acids that contribute to overall well-being and health (Sarwat, 2023). However, alongside these nutritional benefits is the risk of foodborne pathogens. Gastropod mollusks may harbor naturally occurring pathogens in marine environments, such as *Vibrio* spp. and *Salmonella* spp., which can cause mild to serious illnesses in humans when contaminated shellfish are consumed (Mancini et al., 2023; Brauge et al., 2024).

These scenarios are caused by the natural aquatic environments, but are commonly worsened by man-made factors like pollution and poor hygienic handling of fish during harvesting, processing, or marketing (WHO, 2024; Igbinosa & Okoh, 2020; Yousuf et al., 2022).

Gastropod mollusks, such as *C. urceus* (locally known as anikad or sikad-sikad), with different ecological behaviors and anatomical characteristics than other marine organisms, make them potential reservoirs of pathogenic microorganisms. Gastropods are bottom-dwelling organisms that are in constant contact with sediments and coastal waters, where bacteria such as *Vibrio* spp. and *Salmonella* spp. can persist (Desdouits et al., 2023). The ingestion and accumulation of microorganisms from their surrounding environment are facilitated by their feeding habits, such as grazing on detritus, algae, and biofilms (Akomea-Frempong et al., 2023). In addition, what allows bacteria to survive and multiply is their soft, mucus-covered tissues and coiled shell structures that can trap sediments and harbor microbes (Kijewska et al., 2023). Lastly, gastropods as vectors of foodborne pathogens are a matter of significant concern, particularly when consumed raw or undercooked. These scenarios need to be addressed, emphasizing the need for continuous monitoring of gastropod mollusks in the Philippines to evaluate microbial and chemical contaminants for public health protection.

A study conducted along the Moroccan Atlantic coast highlighted the role of marine organisms as reservoirs of pathogenic bacteria, with the detection of both *Vibrio* spp. and *Salmonella* spp. in coastal mussels (Mannas et al., 2014). Another study by Leister et al. (2023) emphasized that gastropods can carry and transmit pathogenic microorganisms by examining fecal indicator bacteria in the excreta of three gastropod genera (*Arion*, *Helix*,

and *Cepaea*). Furthermore, the European Food Safety Authority (EFSA) highlighted the significance of monitoring these pathogens in marine organisms to protect public health and ensure food safety (EFSA Panel on Biological Hazards [BIOHAZ], 2024). These studies collectively underscore the importance of monitoring both water and aquatic life for pathogenic bacteria, as their presence can threaten food safety and public health, especially in gastropod mollusks.

Few studies have also been conducted in the Philippines on bacterial contamination in gastropods. In Langihan Lagoon, Butuan City, researchers detected high total coliform counts in the gastropod population, exceeding safe limits for human consumption, likely due to direct discharge of domestic, livestock, and market waste (Dollano et al., 2025). Another study focused on gastropods associated with mangroves in the Iloilo River and highlighted their role in harboring bacteria. They found isolates that are capable of inhibiting pathogens such as *E. coli* and *S. aureus* (Tupas et al., 2025). The diversity and infection dynamics of gastropods in Lake Mainit, Philippines, were studied by (Jumawan et al., 2025), who discovered that gastropod populations' microbial contamination may be influenced by environmental factors. A study in Pujada Bay, Davao Oriental, examined the human health risks associated with heavy metals and the antibacterial activity of *Curceus*. It emphasized the importance of assessing microbial contamination in these gastropods to ensure seafood safety (Tayone et al., 2020). It has also been acknowledged that *Salmonella* spp. are present in seafood and coastlines in several locations in the Philippines, suggesting fecal pollution and poor sanitation practices.

The coastlines of Tudela, Misamis Occidental, are a vital source of food and livelihood for the local community and even for neighboring municipalities. These

brackish waters are conducive to a variety of marine creatures, including gastropods like *C. urceus* (Diamante et al., 2024). However, halophilic bacteria such as *Vibrio* spp., known to thrive in saline-to- brackish habitats, are also encouraged to grow in these environments. In addition, enteric bacteria such as *Salmonella* spp. may contaminate these waters through domestic sewage, agricultural runoff, and waste discharges from nearby settlements (Aaron Awere-Duodu et al., 2025; Zhu et al., 2023). A study conducted in Thailand's major oyster farming zones reported that *Salmonella* spp. (2.5%) Moreover, *V. parahaemolyticus* (74.9%) was detected in coastal water samples, with contamination influenced by wastewater discharge and runoff from surrounding coastal communities (Jeamsripong et al., 2022). Notably, mollusks are often sold unrefrigerated in wet markets or by roadside stalls, making them particularly susceptible to microbial growth during handling and storage.

Prior studies conducted in nearby Mindanao regions have highlighted potential public health risks associated with the presence of *V. parahaemolyticus* and *V. vulnificus* in coastal and aquaculture areas (Acta Medica Philippina, 2020; Cab International, 2015; Tunung et al., 2016). *Vibrio* spp. have also been detected in mollusks from coastal waters of the Philippines, according to a local study. For instance, Tabo et al. (2015) discovered *V. parahaemolyticus* and *V. vulnificus* in green mussels (*Perna viridis*) from Bacoor Bay, Cavite, and *V. cholerae* and *V. parahaemolyticus* were identified in oysters and mussels from aquaculture areas in the Visayas, in a study by Nuñal et al. (2023). Also, Lao et al. (2025) reported the presence of *Salmonella* spp. in commercially sold oysters. The researchers explained that bivalve mollusks can accumulate microorganisms from polluted water through filter-feeding. Despite these findings, there is still a lack of

studies. on the prevalence of *Vibrio* spp. and *Salmonella* spp. in marine gastropods collected from Tudela, Misamis Occidental, because most studies are focused solely on investigating and assessing the presence of enteric pathogens in bivalve mollusks and other seafood, creating a gap in the available data on food safety when it comes to gastropod mollusks like *C. urceus*. Addressing this gap is important for the regional safety surveillance program and creating baseline data on the microbiological quality of gastropods consumed in the province.

Objectives of the Study

This study generally aimed to determine whether commercially sold gastropods, such as *C. urceus* sourced from Tudela, Misamis Occidental, are contaminated with *Vibrio* spp. and *Salmonella* spp. Additionally, this study aimed to address the research gap in the specified area by contributing to the limited information on foodborne pathogens in its fisheries. This study specifically aimed to:

1. Quantify the bacterial load of commercially sold aninikad (*C. urceus*) using the total plate count expressed as colony-forming units per gram (CFU/g);
2. Determine the presence or absence of *Vibrio* spp. and *Salmonella* spp. in the samples and identify whether results are positive or negative for the target microorganisms; and
3. Evaluate the level of contamination risk based on the computed $\log_{10}$ CFU/g values compared with the established risk thresholds and corresponding contamination interpretations.

Significance of the Study

The findings of this study deepen understanding of pathogen prevalence in the marine ecosystems of Tudela, Misamis Occidental, by determining the occurrence of *Vibrio* spp. and *Salmonella* spp. in commercially sold *C. urceus*, thereby providing information on the microbiological quality of this edible gastropod commonly consumed and traded in the area.

For local consumers, seafood vendors, and fisherfolk, the study offers valuable information to guide safer handling, preparation, and consumption practices. The findings of this study help reduce the incidence of foodborne and waterborne diseases, protect consumer health, and minimize financial losses associated with product rejection, reduced marketability, and erosion of consumer confidence by identifying potential microbial hazards.

For local government units, regulatory agencies, and public health authorities, the results serve as a scientific basis for strengthening monitoring programs, improving seafood quality standards, and implementing evidence-based food safety policies, health advisories, sanitation measures, and environmental management strategies. It also supports the development of community intervention programs that are aimed at preventing foodborne and waterborne infections and promoting sustainable fisheries practices.

For the academic community, particularly students and researchers in microbiology, food science, fisheries, and public health, this study contributes to the existing body of

knowledge for future pathogen surveillance, microbial risk assessment, and comparative studies involving marine food products.

For the profession of Medical Technology and related disciplines, this highlights the importance of microbiological testing and surveillance in disease prevention, outbreak investigation, and public health monitoring, and demonstrates how laboratory findings can guide food safety programs, environmental management, and community-based health interventions.

Overall, this research provides essential baseline information that can enhance food safety monitoring and guide the development of public health strategies for communities that rely on the coastal resources of Tudela, Misamis Occidental, as an important source of food, livelihood, and economic stability.

Scope and Delimitations

This study focused solely on investigating the contamination of foodborne pathogens, specifically *Vibrio* spp. and *Salmonella* spp., in commonly marketed and consumed *C. urceus* gastropods sourced from Tudela, Misamis Occidental. The study is limited to the samples collected from this locality and does not generalize to gastropods from other geographic areas. Moreover, the study is restricted to laboratory-based detection of the specified pathogenic bacteria and does not include evaluation of other contaminants, such as chemicals, parasites, or other microbial species. Lastly, the study was constrained by the availability of laboratory resources, materials, and equipment, as well as financial limitations, which limited the extent of microbial analysis, replication,

and the range of tests performed. Seasonal variations, environmental factors, and regulatory restrictions also limited the number of samples collected. Consequently, the results should be interpreted in light of these limitations.

MATERIALS AND METHODS

Research Design

This study used a descriptive, cross-sectional research design. The descriptive design is appropriate since the goal of the study is to document the occurrence of *Vibrio* spp. and *Salmonella* spp. in the *C. urceus* collected from the coastal areas of Tudela, Misamis Occidental. The study is cross-sectional because, within a set period, data are collected only once; it provides an overview of the microbiological quality of marketed *C. urceus* sourced from the specified location. Furthermore, the most important step in data collection is laboratory analysis, which provides the most reliable method for confirming the presence of these foodborne pathogens (Domingo et al., 2022). An essential part of the research, as it led to the identification of *Vibrio* spp. and *Salmonella* spp. in *C. urceus*, which established the study's outcomes. To verify the presence of *Vibrio* spp. and *Salmonella* spp. in the samples, microbiological methods were used in accordance with standard protocols. The results of the laboratory analysis were compiled, measured, and examined to provide a baseline on the occurrence of the specified pathogens in the study area.

Research Setting

The study was carried out in Tudela, Misamis Occidental (8.255547°N, 123.848273°E) (Figure 1), the location where our gastropod samples (*C. urceus*) were collected and purchased. This location was selected because of its proximity to freshly collected gastropods, ensuring the availability of samples and ease of transport.

Conducting the study in this area will also depict the customers' daily exposure to potential health risks, producing fundamental information crucial to public health protection and food safety in Tudela, Misamis Occidental, as well as surrounding municipalities.

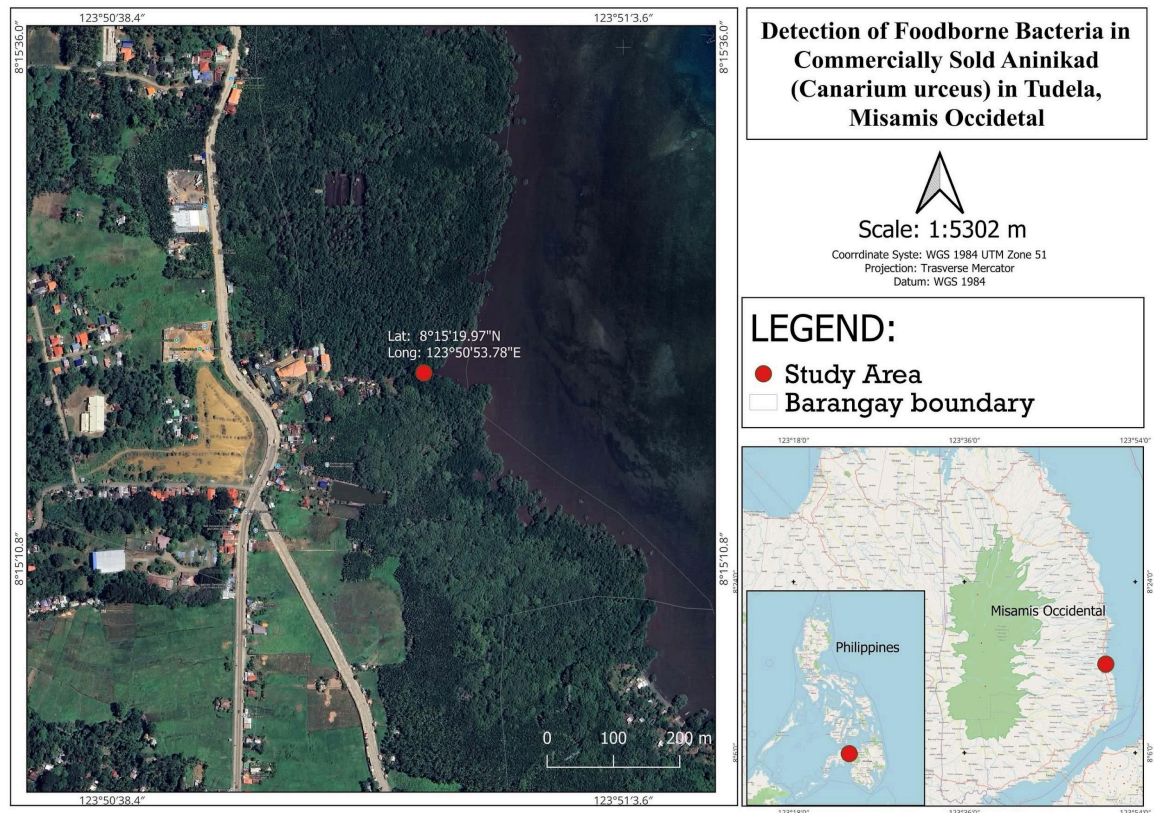


Figure 1. Map of the study site (Tudela, Misamis Occidental)

Sample Species Identification

The samples used in this study underwent proper species identification. Aninikad samples collected from Tudela, Misamis Occidental were sent to the Bureau of Fisheries and Aquatic Resources (BFAR) – Region X, Cagayan de Oro City office for its

morphological analysis. The submitted samples were identified as *Canarium urceus* (Linnaeus, 1758), locally known as "Aninikad" (Figure 2).



Figure 2. *Canarium urceus* (Linnaeus, 1758) locally known as “Aninikad”

Sample Collection, Storage and Transport

The samples were collected from Tudela, Misamis Occidental through a single source. A total of one and a half (1.5) kilograms of samples were purchased and used for the study, determined based on feasibility, time constraints, and resource availability. Only fresh, whole samples intended for human consumption were included; dead/rotten, frozen, or pre-cleaned samples were excluded. The collected samples were sealed in a sterile plastic sampling bag and a secondary container or zip-lock bag, then labeled with necessary information, such as the location and the date and time of collection (U.S. FDA BAM, 2022).

The samples were then stored in an insulated cooler with ice packs to maintain a temperature below 10°C during transport. Using a thermometer, the temperature inside

the cooler was monitored. Subsequently, within 2-3 hours of collection, the samples were delivered to the laboratory and processed immediately (U.S. FDA BAM, 2022).

Sample Preparation, Isolation and Identification of Bacteria

Standard procedures of the U.S. Food and Drug Administration Bacteriology Analytical Manual were followed, with some modifications (Dumaloan-Canini et al., 2024). The collected samples were first rinsed with distilled water to remove any adhering debris, after which the soft tissues were aseptically removed from the shells using sterile equipment and placed in a sterile container.

For *Salmonella* spp. isolation: 25 grams of the sample were aseptically mixed with 225 mL of sterile Buffered Peptone Water (BPW) in a sterile blender and transferred to a 500-mL Erlenmeyer flask, which was incubated at 35–37 °C for 18- 24 hours for non-selective pre- enrichment. After gentle mixing, 0.1 mL of the pre- enriched suspension was inoculated into three tubes containing 10 mL of Rappaport–Vassiliadis (RV) medium, which were incubated for 24 ± 2 h at $42 \pm 0.2^{\circ}\text{C}$. This was followed by plating the cultivated colonies onto three Salmonella-Shigella (SS) agar selective medium tubes, then incubating at 35°C. The presumptive colonies were identified based on standard culture characteristics.

For *Vibrio* spp. isolation, 25 grams of the samples were mixed with 225 mL Alkaline Peptone Water (APW) using a sterile blender to create a homogenate, which was then transferred into a 500-mL Erlenmeyer flask. A ten-fold serial dilution was followed as described in the manual. The tubes were then incubated at 37°C for 18 hours. Each tube with suspected growth was then inoculated onto three Thiosulfate-Citrate-Bile

Salts-Sucrose (TCBS) agar plates and incubated at 37°C for 18-24 hours. The colony morphology of *V. parahaemolyticus* exhibits round, opaque, and greenish or bluish color, while *V. cholerae*, *V. alginolyticus*, and other *Vibrio* species appeared yellow. The colonies isolated were identified based on standard culture characteristics, and isolates were further confirmed using Gram staining, salt tolerance tests, and urease tests.

All procedures were performed under aseptic conditions using sterile media and equipment, and plating procedures and biochemical tests were done in triplicate, following the recommended procedures described in the U.S. Food and Drug Administration Bacteriology Analytical Manual for the preparation and isolation of *Vibrio* spp. and *Salmonella* spp. from seafood and related samples to ensure accuracy and reliability of results.

Ethical Consideration

The study involved purchasing commercially available gastropods (*C. urceus*) from Tudela, Misamis Occidental. Purchasing of samples took place as with normal customers to avoid disturbing vendors' livelihoods, and no vendor identification was recorded for confidentiality purposes.

Biosafety Consideration

All samples were properly labeled with necessary information and transported in sterile leak-proof containers with ice packs. Laboratory processing was conducted at a

Biosafety Level 2 (BSL-2) facility, where standard biosafety procedures, such as the use of personal protective equipment and the performance of aerosol-generating procedures in a class II biosafety cabinet, were observed. All biological wastes were sterilized by autoclaving at 121°C and 15 psi for 15 minutes before disposal. Implementation of the protocols ensured that ethical and biosafety standards were strictly abided by upholding the safety of the researchers, the integrity of the data, and the protection of the community.

Data Analysis

Colony-forming units per gram (CFU/g) were used to measure the number of isolated bacteria in confirmed colonies of *Vibrio* spp. and *Salmonella* spp. in the collected samples. It was determined by multiplying the number of colonies counted by the dilution factor and dividing the result by the volume plated.

$$CFU/g = \frac{(\text{Number of Colonies Counted} \times \text{dilution factor})}{\text{volume plated}} \quad (1)$$

The results were then converted into $\log_{10}$ values using the formula:

$$\log CFU = \log_{10} (CFU) \quad (2)$$

The corresponding log values were then used to evaluate the risk of bacterial contamination. Log values of $\geq 5.0 \log_{10}$ CFU/g for *Vibrio* spp. and $\geq 3.0 \log_{10}$ CFU/g for *Salmonella* spp. indicate a medium-to-high risk of contamination. Conversely, log CFU values of $\leq 5.0 \log_{10}$ CFU/g for *Vibrio* spp. and $\leq 3.0 \log_{10}$ CFU/g for *Salmonella* spp. were classified as no-to-low risk (Dumaloan-Canini et al., 2024).

Descriptive statistics were employed in the study. Colony counts were calculated as CFU/g values. The bacterial load was expressed as the mean $\log_{10}$ CFU/g $\pm$ standard deviation (SD) and interpreted according to the established and contamination risk criteria for *Vibrio* spp. and *Salmonella* spp.

RESULTS AND DISCUSSION

Detection of *Vibrio* spp. and *Salmonella* spp.

The study detected *Vibrio* spp. in the analyzed samples (*C. urceus*), specifically identifying *V. cholerae* as the predominant species. However, the target pathogen, *V. parahaemolyticus*, was not detected. Although it was not present in the samples tested, other *Vibrio* spp. were detected. must still be considered because *Vibrio* spp. are the cause of gastrointestinal diseases, wound infection, and septicemia, mainly through consumption or contact with contaminated seafood or water. However, little is known about the pathogenic traits of opportunistic *Vibrio* species, particularly regarding their potential for human infections (Yu, H., & Rhee, M. S., 2026). The isolates produced yellow colonies on TCBS agar, appeared as Gram-negative curved rods, grew at 0% and 3% NaCl, showed no growth at 6%, 8%, and 10% NaCl, and were urease-negative. These results are consistent with the profile of *V. cholerae* based on the manual. The dilution that provided 30–300 colony-forming units (CFU) was selected and counted. Quantitative findings are presented in Table 1, which shows the bacterial load of *Vibrio* spp. in commercially sold aninikad (*C. urceus*) in Tudela, Misamis Occidental. The results are presented in Table 2, which presents the contamination risk level of *Vibrio* spp. in the analyzed samples.

Table 1. Bacterial Load of *Vibrio* spp. in Commercially Sold Aninikad (*C. urceus*) Tudela, Misamis Occidental

Plate	<i>V. parahaemolyticus</i> (CFU)	<i>V. cholerae</i> (CFU)	Computed CFU/g (mL)
1	0	103	1.03×10^7
2	0	92	0.92×10^7
3	0	112	1.12×10^7
Average <i>Vibrio</i> spp. count		1.02×10^7 CFU/g	

The presence of *V. cholerae* in the samples indicates potential contamination originating from the natural marine environment, as *Vibrio* spp. are autochthonous microorganisms in estuarine and coastal waters. Their occurrence in seafood, especially *C. urceus*, is strongly influenced by environmental factors such as temperature, salinity, and organic matter. These factors facilitate their proliferation and persistence. In the context of gastropods like *C. urceus*, these organisms can accumulate bacteria through direct contact with contaminated sediments because they are bottom-dwelling.

Interestingly, the absence of *V. parahaemolyticus* contrasts with many studies that commonly report it as the dominant pathogenic *Vibrio* species in seafood. For instance, a study conducted in Misamis Occidental reported *V. parahaemolyticus* as the most prevalent *Vibrio* species (47%) among seafood samples, followed by *V. cholerae* (16%) (Dumaloan-Canini et al., 2024). The differences between these findings and this study may be attributed to variations in sample type (gastropods vs. mixed seafood), environmental conditions at the collection site, seasonal variation, or even handling and post-harvest practices. The exclusive detection of *V. cholerae* in this study is noteworthy from a public health perspective. Although not all strains of *V. cholerae* are toxigenic, their presence in food products indicates environmental contamination and may pose a risk of foodborne illness. *V. cholerae* is a natural inhabitant of aquatic ecosystems and still possesses adaptive mechanisms that enhance its persistence under changing environmental conditions. One of its most important survival strategies is biofilm formation. Biofilm formation allows the organism to attach to surfaces and protects it from stresses such as fluctuations in salinity, nutrient limitation, and sanitation

procedures. These adaptations facilitate the survival and persistence of *V. cholerae* during the handling and distribution of seafood (Sampaio et al., 2022).

The absence of *V. parahaemolyticus* in the present study may suggest that environmental conditions in Tudela, Misamis Occidental, during the sampling period were less favorable for its proliferation, as *V. parahaemolyticus* occurs in marine and estuarine environments and is influenced by ecological factors, particularly water temperature and salinity. Studies have shown that the organism tends to be more abundant under warm conditions and within specific salinity ranges. In contrast, deviations from these conditions can reduce its prevalence or render it undetectable in seafood samples (Padovan et al., 2021).

In contrast to *Vibrio* spp., *Salmonella* spp. were not detected in any of the analyzed samples. No typical *Salmonella* colonies were observed on SS agar. This suggests that the samples examined in this study were free of detectable *Salmonella* spp., indicating good microbiological quality with respect to this pathogen. The absence of *Salmonella* spp. in seafood is not uncommon and may be influenced by several factors. These include the organism's natural ecology and environmental conditions. *Salmonella* is typically introduced through fecal contamination from terrestrial sources, such as human and animal waste, whereas *Vibrio* spp. are indigenous to marine environments. Therefore, its presence in seafood is often associated with poor sanitation, contaminated water sources, or unhygienic handling practices.

Similar findings have been reported in other studies where *Salmonella* spp. was either absent or detected at extremely low prevalence in marine samples. For example,

certain seafood monitoring studies have documented the absence of *Salmonella* spp. across multiple sampling sites, suggesting that contamination is sporadic and highly dependent on external contamination sources (Üçok et al., 2025). This aligns with the results of this study, indicating that the harvesting and handling conditions of aninikad in Tudela, Misamis Occidental, may limit exposure to fecal contamination. However, it is important to note that the absence of *Salmonella* spp. in this study does not rule out the possibility of their presence, as methodological limitations, sample size, or the sensitivity of the techniques used may affect detection. Therefore, while contamination is not impossible, it is not consistently observed across all seafood types and locations.

Bacterial Count of *Vibrio* spp. in *C. urceus*

The level of microbial contamination in the samples was determined by interpreting the computed colony counts and corresponding $\log_{10}$ CFU/g as presented in Table 1. The colony-forming units per gram (CFU/g) of the sample were calculated by counting the visible colonies that developed in the culture plates; these results were then converted into $\log_{10}$ values for easier interpretation of contamination levels. The bacterial load of *V. cholerae* ranged from 0.92×10^7 to 1.12×10^7 CFU/g (mL), with a computed mean of 1.02×10^7 CFU/g (mL) ($\pm 1.00 \times 10^6$ SD), indicating a high bacterial load in the samples tested. The high $\log_{10}$ CFU/g values further confirm the high bacterial load in commercially sold aninikad (*C. urceus*) collected from Tudela, Misamis Occidental, which is often directly related to environmental conditions, poor sanitation, and handling. In contrast, the absence of *Salmonella* spp. growth indicates that the sample may not have

been contaminated at detectable levels during the time of analysis; also, the natural environmental factors such as temperature, microbial competition, and salinity may contribute to the absence of *Salmonella* spp.

Environmental contamination in aquatic habitats where gastropods are naturally found potentially explains the presence of *V. cholerae*. Since *C. urceus* is frequently exposed to surrounding sediments and seawater, it may accumulate microorganisms through environmental contact. Contamination may also be affected by temperature, since during April to May the coast of Tudela, Misamis Occidental is usually very hot due to the dry season; and, as anticipated, the occurrence and levels of *Vibrio* spp. will increase in response to extreme weather and coastal warming (Konstantinos et al., 2024). The presence of *V. cholerae* can also be influenced by the mode of transport, handling conditions, and storage prior to sample collection.

Variations in bacterial counts among replicate plates may reflect the natural distribution of microorganisms within the samples. Uneven bacterial dispersion during the preparation of samples and dilution procedures can influence formation of colonies on agar plates. Inconsistency in pipetting, human colony-counting error, and differences in inoculum distribution are minor procedural factors that may contribute to variations in colony counts. However, the comparatively low standard deviation of the results indicates consistency in the distribution of bacterial colonies across the samples.

Understanding bacterial counts is essential for assessing microbial contamination in food, water, and clinical samples (Khdir, 2024). Higher bacterial counts may indicate increased contamination. The detection of *V. cholerae* indicates the need for proper food

sanitation and handling, and proper cooking standards of *C. urceus* must be followed; most seafood should be cooked to an internal temperature of 145°F or 63°C (U.S. FDA, 2022), this is important to reduce the risk of foodborne infections. These findings emphasize the importance of monitoring commercially sold aninikad (*C. urceus*) to ensure food quality and consumer safety.

Risk Level of *Vibrio* spp. Contamination on *C. urceus*

The contamination risk level of *V. cholerae* in *C. urceus* was classified based on a mean value of 7.009 log₁₀ CFU/g, indicating a consistently high bacterial load across all samples. Since the *Vibrio* spp. counts of ≥ 5.0 log₁₀ CFU/g suggest elevated bacterial contamination in shellfish; this means the samples are classified as having medium-to-high risk of contamination (Dumaloan-Canini et al., 2024). These findings indicate that the samples may have been exposed to aquatic environments with warm, coastal, and brackish waters, which favor *Vibrio* proliferation.

The interpretation of bacterial contamination for risk assessment involved the log₁₀ CFU/g measurement and a microbiological risk calculation. Generally, higher log values indicate higher bacterial concentration and contamination severity. As a result, a mean value of 7.009 ± 0.005 log₁₀ CFU/g $\pm$ SD translates to the existence of medium contamination risk. Quantitatively, the bacterial load of *V. cholerae* was 0.92×10^7 to 1.12×10^7 CFU/g, with a computed mean of 1.02×10^7 CFU/g. The low standard deviation indicates consistency across replicates and in bacterial distribution.

A medium-to-high degree of contamination poses health risks to people who consume seafood, especially the immunocompromised, the elderly, and others with medical conditions. *Vibrio* spp., especially *V. cholerae*, are known pathogens capable of causing gastroenteritis in humans, posing a risk of contracting foodborne diseases. Seafood-borne *Vibrio* infection can cause serious illness in consumers (Baker-Austin et al., 2018).

The statistical analysis reveals that the values obtained are similar across all replicates, validating the plating method and indicating that the measured bacterial content is representative of the bacteria present in the sample rather than contamination.

Table 2. Level of Contamination Risk of *Vibrio* spp. on Aninikad (*C. urceus*) in Tudela, Misamis Occidental

Plate	CFU/mL	Log ₁₀ CFU/g (mL)
1	1.03×10^7	7.013
2	0.92×10^7	6.964
3	1.12×10^7	7.049
Ave. Log₁₀ CFU/g ± SD	7.009 ± 0.005	Medium-to-High risk level

Table 3. Basis for Interpretation on *Vibrio* spp. Contamination Risk on Aninikad (*C. urceus*) in Tudela, Misamis Occidental

Microorganism	Log ₁₀ CFU/g Value	Interpretation	Contamination Risk Level
<i>Vibrio</i> spp.	$\leq 5.0 \log_{10}$ CFU/g	No-to-low risk of transmitting pathogenic bacteria.	Low risk
	$\geq 5.0 \log_{10}$ CFU/g	Elevated bacteria contamination and possible transmission of pathogenic bacteria.	Medium-to-High risk

CONCLUSION AND RECOMMENDATIONS

This study revealed that *Vibrio* spp. specifically *V. cholerae*, is present in the aninikad (*C. urceus*) commercially sold in Tudela, Misamis Occidental, while *V. parahaemolyticus* and *Salmonella* spp. were not detected in the tested samples. The detection of *V. cholerae* underscores the importance of monitoring and control of seafood products for microbial contamination and highlights potential public health risks, especially when seafood is improperly handled or eaten raw or undercooked. The absence of *Salmonella* spp. is a positive finding; however, it does not rule out the possibility that other harmful microorganisms may still be present in the samples and in other marine products. The environmental conditions, harvesting practices, and improper handling may all contribute to microbial contamination in gastropods.

In light of these results, a few suggestions were made to reduce and possibly eliminate the risk of bacterial illnesses transmitted through aninikad (*C. urceus*). Consumers are encouraged to properly clean and cook the gastropods and other seafood products before consumption. Vendors should also observe proper sanitation and hygienic handling during the storage, preparation, and sale of gastropods, such as proper handwashing, maintaining proper temperature control, regular cleaning with clean water, and disinfecting equipment and containers. Local authorities and health officials should also continue to strengthen routine microbial monitoring of seafood products sold in markets and coastal communities, such as conducting regular sanitation inspections, food safety education programs, and monitoring coastal water quality.

Rules and regulations on promoting food safety standards need to be updated and enforced. If followed consistently and collaboratively, these suggestions will significantly aid in maintaining public health and seafood safety not only in Tudela, Misamis Occidental, but also in neighboring municipalities and regions.

DECLARATION OF THE USE OF AI TOOLS

We acknowledge the use of Grammarly in assisting us in reviewing the spelling, grammar, spacing, and sentence construction in our whole paper during the final stage of writing.

We used the output to correct grammatical errors and improve the manuscript's clarity and readability.

Moreover, we acknowledge the use of ChatGPT (<https://chat.openai.com/>) to assist our group in generating ideas for the introduction and in identifying relevant literature related to our study.

We entered the following prompts: “Provide background information about our research topic.” and “Suggest related studies and literature relevant to foodborne bacteria in gastropods”. We then decided which citations to include in our study, provided that they were verifiable, existing, and current.

We used the outputs as a starting point for generating ideas in the introduction and as a guide in identifying potential literature for our Review of Related Literature.

Lastly, we acknowledge the use of QuillBot (<https://quillbot.com/>) in assisting our group in paraphrasing selected portions of the manuscript.

We used the output to rephrase selected parts of the paper while preserving their original meaning and improving conciseness and clarity.

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APPENDICES

APPENDIX A

Approved Letter of Consent



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)

Date: January 29, 2026

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

Subject: *Request for Permission to Use Laboratory Equipment, Rooms, and Reagents for Research Data Gathering*

Dear Dean Villanueva,

We, the undersigned undergraduate researchers from the College of Medical Technology, respectfully seek permission from your good office to **use selected laboratory equipment, laboratory rooms, and reagents located at the Natural Sciences Building** under the College of Arts and Sciences. This request is in line with our ongoing research data gathering for our research paper entitled:

“Microbiological Assessment of Foodborne Bacteria in *Aninikad* Collected from Wet Markets in Misamis Occidental”

The experimental procedures of our study are scheduled to be conducted from **February to March 2026**. The facilities and resources available at the National Science Building are essential for the successful completion of specific laboratory components of our research.

We give our full assurance that all laboratory work will be carried out **in accordance with university rules and regulations**, under proper supervision, and with utmost care for laboratory safety, cleanliness, and responsible use of equipment and reagents. We likewise commit to restoring all facilities to their proper condition after use.

Furthermore, all information and data obtained will be utilized **exclusively for academic research purposes**, and due acknowledgment will be given to the College of Arts and Sciences and the National Science Building in all research outputs.

We humbly request your approval and support for this academic endeavor. Your favorable response will greatly aid us in completing our research requirements.

Thank you very much for your time and kind consideration.

APPENDIX A CONT'D



Misamis University

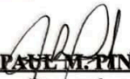
Ozamiz City

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,


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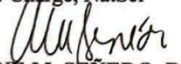

KASSANDRA CORINNE Y. MARASIGAN

Researcher
BS-Medtech Year

Noted by:


RUTHIE M. BALASABAS, MBA-HHA, AMT, RMT
Research Adviser

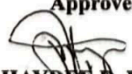

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Recommending Approval:


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Chairperson, Department of Natural Sciences

Approved by:


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

APPENDIX A 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)

Date: 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 purposes*

Dear Sir Yasay,

Good day.

We, the undersigned undergraduate researchers from Misamis University - College of Medical Technology, respectfully write to you regarding our research study entitled:

"Microbiological Assessment of Foodborne Bacteria in *Canarium urceus* (Aninikad) Collected from Wet Markets in Misamis Occidental".

The purpose of this letter is to formally request assistance in the species identification of the aninikad samples collected for our scientific study, as accurate identification is essential to the validity of our research.

This study is conducted solely for academic and research purposes, and all sample collection was carried out ethically and in accordance with established scientific standards. Should the Bureau of Fisheries and Aquatic Resources (BFAR) require a live specimen for proper identification, we would be willing to coordinate accordingly and may be contacted at your convenience.

We sincerely hope for your kind consideration and approval of this request.

Thank you very much for your time and consideration.

Jessie Angeles Aranas

BFAR-10 / PFO-MIS. OCC.
RECEIVED BY :
DATE : 4-17-2026
TIME : 10:42 Am

APPENDIX A 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,

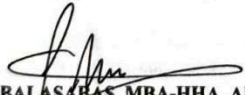

JOHN PAUL M. PINATACAN
Researcher
BS-Medtech Year 3


XYLLIENGEN RUTHER P. PUTOL
Researcher
BS-Medtech Year 3


AUBREY ANN G. SEDEÑO
Researcher
BS-Medtech Year 3

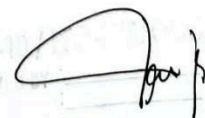

KASSANDRA CORINNE Y. MARASIGAN
Researcher
BS-Medtech Year

Noted by:


RUTHIE M. BALASABAS, MBA-HHA, AMT, RMT
Research Adviser

Approved by:


EVANGELINE M. SENEDO, RMT, MATMRS
Dean, College of Medical Technology



APPENDIX A CONT'D

 **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: January 29, 2024

Name of Authors: Sedeño, Aubrey Ann G, Putel, Xulliangen Rother, Pinatacan, John Paul, Marañan, Kassandra
College/Department: COLLEGE OF MEDICAL TECHNOLOGY
Research Title: MICROBIOLOGICAL ASSESSMENT OF FOODBORNE BACTERIA IN COMMERCIALY SOLD ANINIKAD (Canarium urceus) IN TUDELA, MIS - OCC.

Data Gathering Procedure:

a. Type of Research: (Kindly check)

☐ Quantitative	☐ Qualitative	☒ Experimental
☒ Approved Research Title & Problem/Objectives	☒ Approved Data Gathering Procedure	☒ Approved Data Gathering Instrument/Data Sheets

b. Respondents/Participants/Subject/Samples to be Collected: Canarium urceus (Aninikad)

c. Procedure:

☐ Survey	☐ Interview	☐ Experimentation	☒ Laboratory Testing
---------------------------------	------------------------------------	--	--

d. Place of Implementation/Study Area: Natural Science Laboratory at Misamis University

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

☐ Own private vehicle	☒ public utility vehicle	☐ rental	☐ Others, please indicate _____
--	--	---------------------------------	--

e. Date/s of Implementation/Sampling: February to March 2024

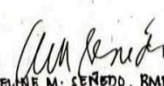
Attachments:

☐ Approved Letter of Consent from the designated authority in the area/place where the study is to be conducted
☒ Signed Parents' Consent

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

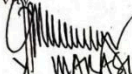
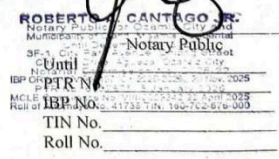
Recommended by:

 RUTHIE M. BALASABAS Thesis/Research Adviser	 NBLFA D. CANINI Thesis/Research Instructor
--	---

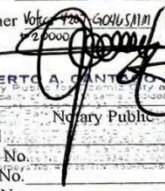
Approved by: 
EVANGELINE M. SEDEÑO, RMT, MATRES
College Dean

CONTROLLED DOCUMENT

APPENDIX A CONT'D

	MISAMIS UNIVERSITY Ozamiz City Department of Student Affairs & Services
MU-DSAS-006/02 June 2023	
PARENT'S CONSENT	
Sponsoring Group/Organization	
I am allowing my son/daughter/ward, <u>KASSANDRA CORINNE Y. MARASIGAN</u>, to join the <u>RESEARCH DATA COLLECTION AND EXPERIMENTATION</u> (activity) to be held on <u>FEBRUARY TO MARCH 2024</u> at <u>MISAMIS UNIVERSITY</u> under the supervision of <u>RUTHIE M. DALAARDAI</u> (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.	
 <u>GINA Y. MARASIGAN</u> Signature over printed name of Parent/Guardian	<u>01/22/24</u> Date
 <u>KASSANDRA CORINNE Y. MARASIGAN</u> Signature over printed name of Student	<u>01/22/24</u> Date
<i>Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.</i> SUBSCRIBED AND SWORN to before me, this <u>23 JAN 2024</u> at <u>OZAMIZ CITY</u>, Philippines, that the herein affiant personally came and appeared with his/her <u>PH ID NO. 08-00244</u>, as evidence of his/her personal identity.	
Doc. No. <u>420</u> Page No. <u>22</u> Book No. <u>XIV</u> Series of <u>2024</u>	 ROBERTO CANTAGO JR. Notary Public Notary Seal 3F-1 C.O. No. 123456789 Until 12/31/2025 IBP No. 123456789 PTR No. 123456789 TIN No. 123456789 Roll No. 123456789
(For DSAS Personnel only) Attested by:  RODEL L. BALDADO, MHist, MAEd OIC, Department of Student Affairs & Services Date: _____	

APPENDIX A CONT'D

	MISAMIS UNIVERSITY <i>Ozamiz City</i> Department of Student Affairs & Services
MU-DSAS-006/02June2023	
PARENT'S CONSENT	
Sponsoring Group/Organization	
I am allowing my son/daughter/ward, <u>JOHN PAUL M. PINATACAN</u>, to join the <u>RESEARCH DATA COLLECTION AND EXPERIMENTATION</u> (activity) to be held on <u>FEBRUARY - MARCH 2026</u> at <u>MISAMIS UNIVERSITY</u> under the supervision of <u>RUTHIE M. BALASABAS</u> (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.	
<i>M. Pinatacan</i> <u>MELANIE M. PINATACAN</u> Signature over printed name of Parent/Guardian	<u>01/22/26</u> Date
<i>John Paul M. Pinatacan</i> <u>JOHN PAUL M. PINATACAN</u> Signature over printed name of Student	<u>01/22/26</u> Date
<i>Important: This form shall be submitted to the DSAS Office at least two (2) days before the conduct of the activity.</i>	
SUBSCRIBED AND SWORN to before me, this <u>23</u> day of <u>JAN</u>, 2026 at <u>OZAMIZ CITY</u>, Philippines, that the herein affiant personally came and appeared with his/her <u>Valid ID</u> as evidence of his/her personal identity.	
Doc. No. <u>422</u> Page No. <u>32</u> Book No. <u>XIV</u> Series of 20<u>26</u>	 ROBERTO A. CANTERO JR. Notary Public City: <u>Ozamiz City</u> Notary Public Until: <u>2026</u> PTR No. <u>2026</u> IBP No. <u>2026</u> TIN No. <u>2026</u> Roll No. <u>2026</u>
(For DSAS Personnel only) Attested by:  RODEL L. BALDADO, MHist, MAEd OIC, Department of Student Affairs & Services Date: _____	

APPENDIX A CONT'D



MISAMIS UNIVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02June2023

PARENT'S CONSENT

Sponsoring Group/Organization

I am allowing my son/daughter/ward, Rital, Xilwengen Rutter, to join the Research Data Collection and Experimental (activity) to be held on February to March at Misamis University under the supervision of RUTHIE M. BALACABAJ (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.

Janice P. Escopete
Signature over printed name of
Parent/Guardian

JAN. 22. 2024
Date

Rital, Xilwengen Rutter
Signature over printed name of
Student

JAN. 22. 2024
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 23 JAN 2024 day of OZAMIZ CITY, Philippines, that the herein affiant personally came and appeared with his/her personal identity.

Doc. No. 419
Page No. 31
Book No. XIV
Series of 2024

ROBERTO A. CANTAGO JR.
Notary Public for Ozamiz City and
Municipality of Misamis Oriental
3F, 3rd Floor, City Hall, Ozamiz City
Notary Public
IBP No. 123456789 Exp. Nov. 2025
MCL No. 123456789 Exp. April 2028
Roll of Attorneys No. 41748 TIN: 123-456-789-000
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 UNIVERSITY
Ozamiz City
Department of Student Affairs & Services

MU-DSAS-006/02 June 2023

PARENT'S CONSENT

Sponsoring Group/Organization

I am allowing my son/daughter/ward, AUBREY ANN G. SEDEÑO, to join the RESEARCH DATA COLLECTION AND EXPERIMENTATION (activity) to be held on FEBRUARY TO MARCH 2026 at MISAMIS UNIVERSITY under the supervision of RUTHIE M. BALASABAS (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.

DELIA S. ROMPALES
Signature over printed name of
Parent/Guardian

JAN 18, 2026
Date

AUBREY ANN G. SEDEÑO
Signature over printed name of
Student

JAN 22, 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 23 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. 421
Page No. 32
Book No. XIV
Series of 2024

ROBERTO A. CANTAGO JR.
Notary Public - Ozamiz City, Misamis Occidental
3P-1 City Hall
City Hall
Until 2025
PTR No. 1507722676000
MCLP No. 1507722676000
IBP No. 1507722676000
TIN No. 1507722676000
Roll No. 1507722676000

(For DSAS Personnel only)

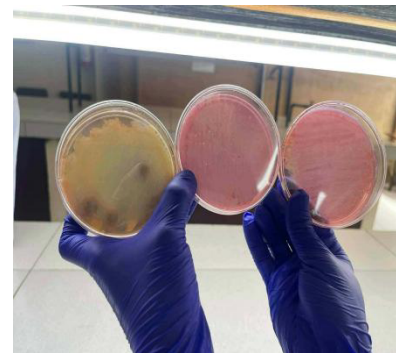
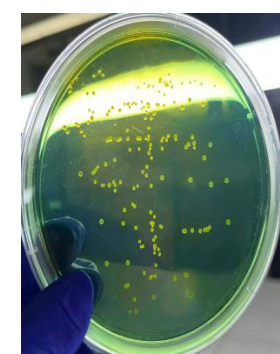
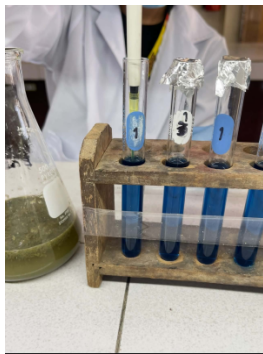
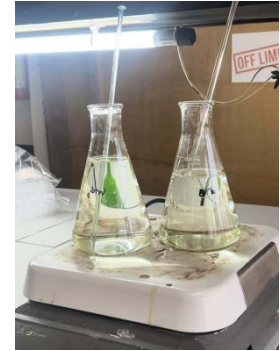
Attested by:

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

Date: _____

APPENDIX B

Documentation



APPENDIX C

Species Identification and Confirmation

 	BUREAU OF FISHERIES AND AQUATIC RESOURCES - 10 Phone: (088) 856-9593 Misabalan, Cagayan de Oro City, Misamis Oriental 9000 Email: bfar10@bfar.da.gov.ph Website: https://r10bfar.da.gov.ph Social Media: https://facebook.com/BFAR10 TIN No.: 000-550-823017	
RESULTS OF ANALYSIS		
Source of Specimen	: Tudela Misamis Occidental	
Submitted by	: John Paul M. Pinatacan et al.	
Address	: Misamis Occidental	
Date Submitted	: April 13, 2026	
Date of Completion	: April 29, 2026	
of Analysis	: April 29, 2026	
Examination	: Morphological Analysis	
Kingdom	: Animalia	
Phylum	: Mollusca	
Class	: Gastropoda	
Order	: Littorinimorpha	
Family	: Strombidae	
Genus	: <i>Canarium</i>	
Species	: <i>urceus</i>	
Scientific Name	: <i>Canarium urceus</i> (Linnaeus, 1758)	
English Name	: Little bear conch	
Local Name	: Aninikad	



Figures: Specimen for morphological analysis of Canarium urceus (Linnaeus, 1758)

References:

MolluscaBase eds. (2026). MolluscaBase. *Canarium urceus* (Linnaeus, 1758). Accessed through:
World Register of Marine Species at:
<https://www.marinespecies.org/aphia.php?p=taxdetails&id=532183> on 2026-04-29

Poutiers, J.M. 1998 Gastropods. p. 363-648. In Carpenter, K. E. and V. H. Niem. 1998. FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 1. Seaweeds, corals, bivalves, and gastropods. Rome, FAO.

Masaganang Agrikultura, Maunlad na Ekonomiya

APPENDIX C CONT'D

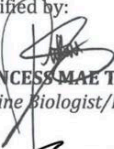


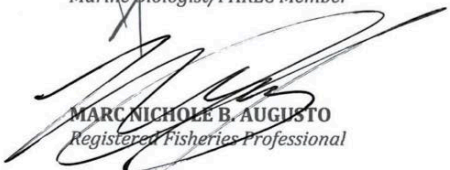
CERTIFICATION

This is to certify that the samples submitted by John Paul M. Pinatacan et al. and received by BFAR-10 last April 13, 2026, were subjected to morphological analysis and were identified as *Canarium urceus* (Linnaeus, 1758) locally known as "Aninikad".

This certification is issued on the 30th 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 D

Turnitin Results



Page 2 of 47 - Integrity Overview

Submission ID trn:oid::28447:144578423

24% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Filtered from the Report

- Bibliography

Match Groups

-  **100 Not Cited or Quoted 19%**
Matches with neither in-text citation nor quotation marks
-  **31 Missing Quotations 5%**
Matches that are still very similar to source material
-  **0 Missing Citation 0%**
Matches that have quotation marks, but no in-text citation
-  **0 Cited and Quoted 0%**
Matches with in-text citation present, but no quotation marks

Top Sources

- 13%  Internet sources
- 8%  Publications
- 19%  Submitted works (Student Papers)

Integrity Flags

0 Integrity Flags for Review

No suspicious text manipulations found.

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.

APPENDIX D CON ‘T

Grammarly Report

Report: Marasigan, Kassandra Corinne Y.

Marasigan, Kassandra Corinne Y.

by Misamis University

General metrics

41,013	5,948	367	23 min 47 sec	45 min 45 sec
characters	words	sentences	reading time	speaking time

Score

99

Writing Issues

5 Issues left **1** Critical **4** Advanced

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

CURRICULUM VITAE

JOHN PAUL M. PINATACAN

Birthdate: June 03, 2004

Home Address: Bonifacio Ext., Leynes Cmpd., Aguada, Ozamiz City,
7200 Philippines

Contact Number: 09054913381

E-mail Address: johnpaulmolavizarpinatacan@gmail.com

EDUCATIONAL BACKGROUND

Tertiary School: Bachelor of Science in Medical Technology
Misamis University
H.T. Feliciano Street, Aguada, Ozamiz City, 7200 Philippines
(2022-2027)

Secondary School: Jimenez Bethel Institute
Naga, Jimenez, Misamis Occidental, 7204 Philippines
(2016-2022)

Primary School: Jimenez Central School
Purok 5, Nacional, Jimenez, Misamis Occidental, 7204 Philippines
(2010-2016)

AUBREY ANN G. SEDEÑO

Birthdate: February 6, 2003
Home Address: Purok Malipayon, Culo, Molave, Zamboanga Del Sur
Contact Number: 09260939596
E-mail Address: aagspriv01@gmail.com

EDUCATIONAL BACKGROUND

Tertiary School: Bachelor of Science in Medical Technology
Misamis University
H.T. Feliciano Street, Aguada, Ozamiz City, 7200 Philippines
(2023-2027)

Secondary School: As-salam High School
Sandakan, Sabah, Malaysia
(2016-2021)

Primary School: As-salam Primari School
Sandakan, Sabah, Malaysia
(2009-2015)

XYLLIENGEN RUTHER P. PUTOL

Birthdate: September 10, 2004
Home Address: Villa Elena Subdivision, Poblacion, Kapatagan, Lanao del Norte
Contact Number: 09706851240
E-mail Address: putolxylliengen@gmail.com

EDUCATIONAL BACKGROUND

Tertiary School: Bachelor of Science in Medical Technology
Misamis University
H.T. Feliciano Street, Aguada, Ozamiz City, 7200 Philippines
(2023-2027)

Secondary School: Kapatagan National High School
Kapatagan, Lanao del Norte
(2017-2023)

Primary School: Kapatagan East Central School
Kapatagan, Lanao del Norte
(2011-2017)

KASSANDRA CORINNE Y. MARASIGAN

Birthdate: September 20, 2004

Home Address: Block 4, Lot 19, R.S Tan Village, Maningcol, Ozamiz City,
Philippines

Contact Number: 09277322656

E-mail Address: marasigankashy@gmail.com

EDUCATIONAL BACKGROUND

Tertiary School: Bachelor of Science in Medical Technology
Misamis University
H.T. Feliciano Street, Aguada, Ozamiz City, 7200 Philippines
(2023-2028)

Secondary School: La Salle University – Ozamiz
Valconcha St., Aguada, Ozamiz City, 7200 Philippines
(2017-2023)

Primary School: La Salle University – Ozamiz
Valconcha St., Aguada, Ozamiz City, 7200 Philippines
(2011-2017)