Faculty of Natural and Applied Sciences Journal of Applied Biological Sciences
Print ISSN: 3027-0685, e-ISSN: 3043-6494
www.fnasjournals.com
Volume 3; Issue 1; March 2026; Page No. 8-15.
DOI: https://doi.org/10.63561/jabs.v3i1.1172

Microbiological Quality of Commercially Available Seafood in Asaba, Delta State, Nigeria

***Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K.**
Department of Microbiology, Dennis Osadebay University, Asaba, Delta State.

***Corresponding author email:** felix.Onoriasakp-obare@dou.edu.ng

Abstract
The microbiological quality of seafood samples was examined based on distribution routes (Ogbeogonogo, Oko, Cable, and Okwe market) and species (shrimp, snail, fish, and crab). Bacterial contaminants were isolated and identified in order to evaluate the microbial quality of the samples. Standard microbiological techniques were used to collect and characterize 32 bacterial isolates. Salmonella spp. (32.08%), Escherichia coli (22.64%), and Staphylococcus aureus (16.98%) were the most common species among the eight bacterial genera that were found. Pseudomonas spp. (5.66%), Enterobacter cloacae (1.89%), and Proteus spp. (1.89%) were found at low frequency, although Listeria spp. and Shigella spp. accounted for 9.43% each. The high prevalence of Salmonella and E. coli suggests significant environmental and fecal contamination, posing a serious threat to public health. Listeria, Shigella, and Staphylococcus species are additional indicators of post-handling and storage contamination. Five main pathogens Salmonella typhi, Escherichia coli, Listeria monocytogenes, Shigella spp., and Staphylococcus aureus were identified by biochemical test results. These organisms are known to cause food poisoning, gastroenteritis, and systemic infections, making them of great public health importance. In order to guarantee safe consumption and lessen outbreaks of foodborne illness, these findings highlight the necessity of better hygiene procedures, microbiological surveillance, and public health education.

Keywords: Microbiological quality, Seafoods, Public Health, Animal Protein, Vitamin

Introduction

When compared to other animal protein sources, seafood is seen as a healthier option. Because they are high in iodine, selenium, vitamin D, and omega-3 fatty acids, they also offer other health advantages (Mahaffey et al., 2008). Seafood has been shown to improve neurological, visual, and cognitive development during pregnancy and infancy as well as prevent cardiovascular disorders (Emmett et al., 2013). Fish eggs, mollusks, crabs, and other types of finfish are all considered seafoods (Iwamoto et al., 2010). Seafood is highly sought after and imported in many parts of the world due to its variety and health advantages. Seafood consumption and demand are constantly rising worldwide. For example, the gross supply of marine items in the United States has grown by over 70% since 1980, reaching 2.2 billion kg in 2009 (Wang et al., 2011). The demand and consumption of fish have increased due to its reported high nutritional value (Adegoke et al., 2010; Ofesi et al.,2025).

One of the most significant public health concerns that is closely related to agricultural and food production processes is the quality of seafood. Eating tainted seafood is a leading cause of hospitalization and mortality, especially in emerging and impoverished nations. Like other food categories, seafood is not immune to food-borne viruses, and eating it is linked to a number of risk factors. Importing nations have hygiene regulations pertaining to seafood (Onoriasakpobare et al., 2024; Abdollahzadeh et al., 2016; Akinnibosun and Adeola, 2015). However, the rising demand for seafood has resulted in a rise in illnesses brought on by seafood consumption (Borresen, 2008). For example, diseases caused by Vibrio spp., Salmonella spp., Listeria monocytogenes, and Escherichia coli have been documented in the past (Lambertz et al., 2013; Graves et al., 2010; Food and Agriculture Organization, 2014). Seafood-derived foodborne infections have become more well-known and pose a risk to public health. The development and application of effective and dependable isolation, detection, differentiation, classification, and/or typing techniques for their surveillance is necessary due to the survival of foodborne pathogens under various environmental circumstances (Ajayi & Omoya, 2017). It is crucial to detect unfamiliar microorganisms during diversity research and study. Pathogenic bacteria and fungi must be identified.

Cite this article as:
Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K. (2026). Microbiological quality of commercially available seafood in Asaba, Delta State, Nigeria. *FNAS Journal of Applied Biological Sciences, 3*(1), 8-15. https://doi.org/10.63561/jabs.v3i1.1172

For millions of people worldwide, seafood is a vital source of protein, vitamins, and important fatty acids. However, because of the possibility of contamination by pathogenic and spoiling microbes, its safety and quality are serious public health issues. Microbial contamination of seafood is largely caused by improper handling, unsanitary processing, insufficient storage, and environmental pollution (Igere et al., 2024).

Foodborne diseases have been linked to pathogens such Vibrio spp., Salmonella spp., *Listeria monocytogenes*, and *Escherichia coli* that have been regularly isolated from seafood (FAO/WHO, 2020). Due to inadequate sanitation and a lack of efficient monitoring systems, the microbiological quality of seafood is frequently impaired in many coastal and seafood-producing regions (ICMSF, 2011). Customers are at serious danger for health problems as a result, particularly in Asaba, Nigeria's Delta state, where raw or minimally cooked fish is consumed. According to studies, improper handling and processing conditions can raise the microbial load, which can cause food spoiling and financial losses (Onojafe et al., 2025; Gram & Dalgaard, 2002).

Despite the growing demand for seafood in Nigeria there is insufficient data on the microbiological quality of seafood in various regions, particularly in Asaba where regulatory enforcement is weak. Therefore, there is an urgent need to assess the microbial load of seafood, identify the predominant microorganisms, and evaluate the effectiveness of current handling and storage practices. This study aims to investigate the microbiological quality of seafood by analyzing microbial contamination levels, identifying potential pathogenic organisms, and assessing the factors influencing contamination. The findings will contribute to improved seafood safety measures and public health protection.

Principal identity of laboratory bacteria is predicated on phenotypic characteristics, morphology, growth on several kinds of culture media, and biochemical testing are performed (Brindha and Ani, 2012). The study was conducted between June to July 2025. Seafood samples were sorted and purchased from seafood sellers operating in major markets of Asaba; Ogbeogonogo market, Cable point market, oko market and Okwe market.

The seafoods samples were purchased from open markets in Asaba. These seafoods were hygienically picked at random and placed in a zip loc bags and placed into a cooler and transported to microbiology research laboratory Dennis Osadebay University, Asaba within 2 hours of collection for microbiological analysis. Fishes, snails, crabs and packs of frozen shrimps were collected once in a week for 4 weeks from different markets in Asaba Delta state.

Results

Seafood samples collected from markets in Asaba exhibited diverse microbial profiles, influenced by handling, storage, and environmental conditions. Common seafood types included fish, shrimp, snail and crabs, with visible signs of spoilage in some samples, such as slimy textures and off-odors, suggesting microbial activity.
A total of Thirty -two (32) seafood samples including Tilapia fish, shrimps, snails and crabs were collected from four major market in Asaba, (Ogbeogonogo, Oko, Cable point and Okwe). The samples were analyzed for microbiological quality by determining the total viable bacterial count, identification of bacterial isolates and performing biochemical characterization of the isolates.

Isolated Microorganisms and colony count of seafoods

Table 1a. Table showing isolated Microorganisms from Ogbeogonogo Market

Samples	**Observation using (SS) Agar**	**Total Viable Bacterial Count (CFU/g ×10⁴)**	**Observation using (MH) Agar**	**Total Viable Bacterial Count (CFU/g ×10⁴)**
Shrimps	Growth of *Escherichia coli* after 24hours .	96	Heavy growth of *Listeria and staphylococcus*	90
Snail	*Salmonella*, *shigella* and *Escherichia coli*	184	*Profuse growth of Salmonella spp* and *Escherichia coli*	152
Tilapia	Growth of *Salmonella spp, shigella* and few strains of *Escherichia coli* suspected.	106	*Enterobacter cloacae* and *staphylococcus spp*.	80

Cite this article as:
Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K. (2026). Microbiological quality of commercially available seafood in Asaba, Delta State, Nigeria. *FNAS Journal of Applied Biological Sciences, 3*(1), 8-15. https://doi.org/10.63561/jabs.v3i1.1172

Crab	Scanty growth of *Salmonella spp confirmed*	128	*Escherichia coli* and *Staphylococcus* seen after 24hours	100

Table 1b. Table showing isolated Microorganisms from Oko Market

Samples	**Observation using (SS)Agar**	**Total Viable Bacterial Count (CFU/g ×10⁴)**	**Observation using (MH)Agar**	**Total Viable Bacterial Count (CFU/g ×10⁴)**
Shrimps	Growth of *Salmonella* spp and *Escherichia coli* seen after 24hours.	42	Heavy growth of *Listeria and staphylococcus*	58
Snail	Presence of *salmonella* and *shigella spp*	112	Pseudomonas spp identified	131
Tilapia	Growth of *Salmonella spp* recorded after the incubation period	120	Profuse growth of *staphylococcus spp*	180
Crab	Profuse growth of *Salmonella typhi* seen	88	Proteus mirabilis identified	76

Table 1c. Table showing isolated Microorganisms from Cable Market

Samples	**Observation using (SS) Agar**	**Total Viable Bacterial Count (CFU/g ×10⁴)**	**Observation using (MH) Agar**	**Total Viable Bacterial Count (CFU/g ×10⁴)**
Shrimps	*Salmonella spp* detected after incubation period	103	Heavy growth of *Listeria and Staphylococcus*	83
Snail	Profuse growth of Salmonella spp seen	160	Heavy growth of *Escherichia coli* and *salmonella spp*	110
Tilapia	*Salmonella spp* and *shigella spp, Escherichia coli*	128	Heavy growth of E.coli and pseudomonas *aeruginosa*	111
Crab	Profuse of *Escherichia coli* and *salmonella spp*	118	*Staphylococcus aureus, Escherichia coli confirmed*	62

Table 1d. Table showing isolated Microorganisms from Okwe Market

SAMPLES	**Observation using (SS) Agar**	**Total Viable Bacterial Count (CFU/g ×10⁴)**	**Observation using(MH) Agar**	**Total Viable Bacterial Count (CFU/g ×10⁴)**
Shrimps	Growth of *Salmonella spp* and *Escherichia coli* seen after 24hours .	54	Heavy growth of *Listeria and staphylococcus*	71
Snail	Growth of *Salmonella spp* seen	124	Heavy growth of *Escherichia coli* and *pseudomonas spp*	102
Tilapia	Heavy growth of *Salmonella spp* after incubation	118	Profuse growth of *Listeria spp* after incubation period	96
Crab	Heavy growth of *Salmonella spp* and *Shigella spp*	108	*Staphylococcus* spp seen after 24hours	104

Cite this article as:
Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K. (2026). Microbiological quality of commercially available seafood in Asaba, Delta State, Nigeria. *FNAS Journal of Applied Biological Sciences, 3*(1), 8-15. https://doi.org/10.63561/jabs.v3i1.1172

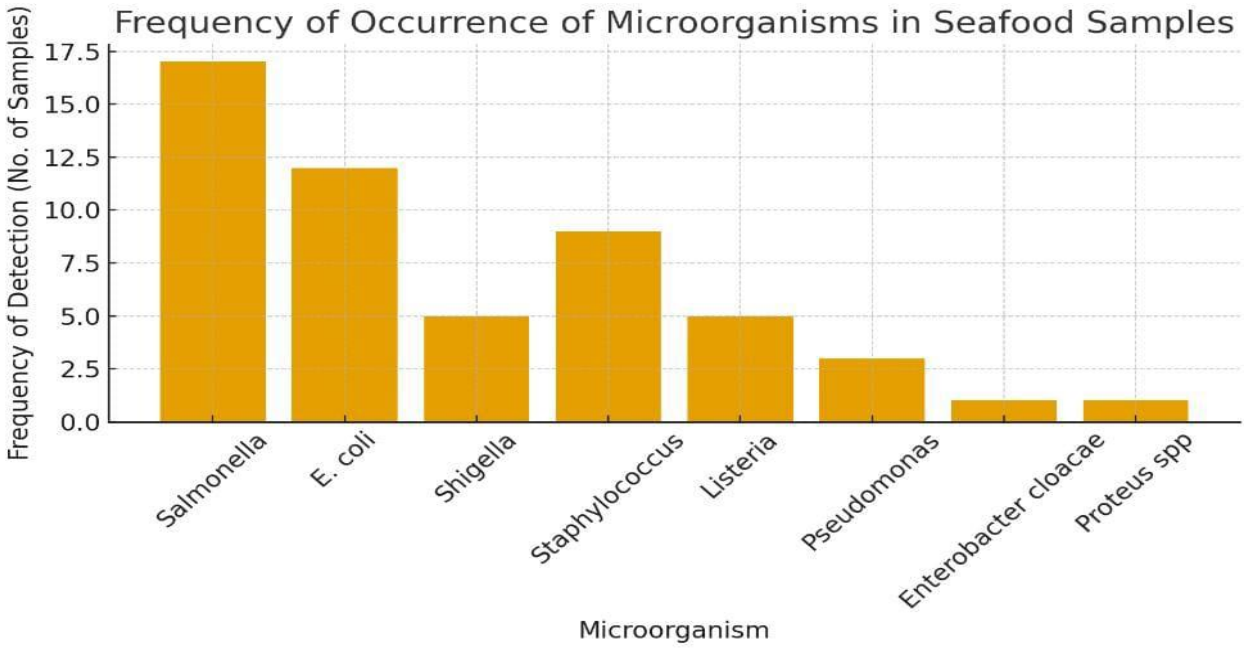
The microorganisms isolated from the seafood samples included *Salmonella spp., E. Coli, Shigella spp., Staphylococcus spp., Listeria spp., Pseudomonas spp., Enterobacter cloacae, and Proteus spp.*

Table 2. Frequency of Occurrence of Isolated Microorganisms
The frequency of detection and percentage occurrence of bacterial isolates obtained from seafood samples analyzed in Asaba . A total of 53 bacterial isolates were observed from 32 seafood samples indicating that multiple bacterial species were detected in several samples.

Micro-Organism	Frequency (no of samples detected)	Percentage (%)
Salmonella spp including (*Salmonella typhi)*	17	32.08
Escherichia coli	12	22.64
Staphylococcus aureus	9	16.98
Listeria spp	5	9.43
Shigella spp	5	9.43
Pseudomonas spp	3	5.66
Enterobacter cloacae	1	1.89
Proteus spp	1	1.89
Total	53	100

Figure 1. Graphical Representation of the Frequency of Microorganisms in Seafood Samples
The frequency of occurrence of Microorganisms in this bar chart shows that *salmonella spp* was the most frequently occurring microorganism, were *Enterobacter cloacae* and *Proteus spp* were the least frequent.

Biochemical Characterization of Isolates
Biochemical tests were conducted on bacterial isolates obtained from seafood samples to determine their taxonomic and physiological properties. These tests included Gram reaction, coagulase, indole, catalase, citrate, oxidase, motility, and fermentation reactions. The results were compared with standard biochemical characteristics for bacterial identification.



Cite this article as:
Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K. (2026). Microbiological quality of commercially available seafood in Asaba, Delta State, Nigeria. *FNAS Journal of Applied Biological Sciences, 3*(1), 8-15. https://doi.org/10.63561/jabs.v3i1.1172

Table 3. Biochemical Characterization of Bacterial Isolates
Biochemical test result confirmed the identity of five major pathogens *Staphylococcus aureus*. *Escherichia coli, Listeria monocytogenes, Shigella spp.,* and *Salmonella typhi*.

S/N	Gram Stain	Shape	Indole Test	Motility Test	Oxidase Test	Catalase Test	Citrate utilization	Suspected Organisms
1	+ve	Cocci	-ve	-ve	-ve	+ve	-ve	*Staphylococcus*
2	-ve	Rod	+ve	+ve	-ve	+ve	-ve	*Escherichia coli*
3	+ve	Rod	-ve	-ve	-ve	+ve	-ve	*Listeria monocytogenes*
4	-ve	Rod	-ve	+ve	-ve	+ve	-ve	*Shigella*
5	-ve	Rod	-ve	-ve	-ve	+ve	+ve	*Salmonella typhi*

Key: + =positive, - =negative

Discussion

This study revealed that a total of Thirty two (32) seafood samples comprising Shrimps, snails, fish and crab were collected from four major markets (Ogbeogonogo, Cable Point, Oko and Okwe market). Seafoods sold in Asaba harbours diverse bacterial species indicating level of contamination that renders the seafood unsafe for direct human consumption. The total viable bacterial counts (TVBC) across samples ranged from 62 $\times 10^4$ to 184 $\times 10^4$ CFU/g, with an overall mean of 114.7 $\times 10^4$ CFU/g. These counts exceed the International Commission on Microbiological Specifications for Foods (ICMSF, 2002) permissible limit of 1.0 $\times 10^5$ CFU/g for fresh seafood, suggesting that the seafoods analyzed were microbiologically compromised.

The highest bacterial counts were recorded in seafoods from Ogbeogonogo Market, followed by Cable Point, Oko, and Okwe markets. This variation reflects differences in environmental sanitation, storage conditions, and handling practices among markets. The high load observed in Ogbeogonogo Market may be attributed to poor drainage, exposure of seafood to flies and dust, and inadequate cold storage. This finding is consistent with Olaoye and Onilude (2019)**,** who reported similar microbial patterns in seafoods from Nigerian open markets, particularly in areas with poor hygiene and limited access to potable water. Likewise, Eze *et al*. (2021) found that fish sold in urban markets of south-eastern Nigeria contained bacterial loads significantly higher than international limits, indicating that seafood contamination is a widespread problem in Nigeria's retail systems. Eight bacterial genera were identified in this study: *Salmonella spp*., *Escherichia coli*, *Shigella spp*., *Staphylococcus* aureus, *Listeria* spp., *Pseudomonas spp.*, *Enterobacter cloacae*, and *Proteus spp.* Among these, *Salmonella spp*. (32.08%) and *E. coli* (22.6%) were the most dominant, while *Pseudomonas*, *Enterobacter*, and *Proteus* occurred in lower frequencies. The high prevalence of *Salmonella spp*. and *E. coli* suggests fecal contamination, likely originating from polluted water sources used during washing or from unhygienic market environments. These results agree with Gram and Dalgaard (2002) and FAO/WHO (2020), which identified these two enteric bacteria as common indicators of fecal pollution in seafoods. Similarly, Obinna-Echem and Eze (2022), in their study of seafoods in Port Harcourt markets, also identified *Salmonella spp*., *E. coli*, and *Staphylococcus aureus* as predominant isolates, attributing contamination to the use of contaminated water and poor sanitation in local markets. *Salmonella spp*. Contamination in seafood has also been reported globally. For instance, Amagliani et al. (2012) detected *Salmonella spp.* In 22% of fish samples in Italy, while Phan *et al.* (2005) found a 24.5% contamination rate in shrimp samples from Vietnam. The similarity between these international findings and the current study highlights that *Salmonella* contamination is a universal issue in seafood safety, particularly in developing regions where hygienic practices are inadequate.

The detection of *E. coli* (22.6%) and *Shigella spp*. (9.4%) indicates contamination from human or animal fecal sources, either through polluted aquatic environments or unsanitary handling. E. *coli* is an established indicator organism of fecal contamination, and its presence suggests that the seafoods were exposed to sewage or waste-contaminated water. This observation supports findings by Ajayi and Omoya (2017), who reported *E. coli* contamination in 18% of aquatic products in Akure, Nigeria, due to direct contact with untreated wastewater. Similarly, Huss *et al*. (2003) identified *E. coli* and *Shigella* as common indicators of post-harvest contamination in fish markets lacking sanitary control. In addition, *Shigella spp*. Detection points to direct human handling contamination, as it is typically transmitted through fecal-oral contact. This further emphasizes the poor hygiene practices among seafood vendors in Asaba markets. *Staphylococcus aureus* was detected in (17.0%) of the

Cite this article as:
Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K. (2026). Microbiological quality of commercially available seafood in Asaba, Delta State, Nigeria. *FNAS Journal of Applied Biological Sciences, 3*(1), 8-15. https://doi.org/10.63561/jabs.v3i1.1172

samples, suggesting contamination during handling, processing, or storage. *S. aureus* is a commensal bacterium found on human skin, nasal passages, and hands, and its presence in seafood reflects inadequate personal hygiene among handlers. This result is in agreement with Eze et al. (2021)**,** who identified *S. aureus* in seafoods from Nigerian coastal markets, linking contamination to improper handling and exposure to air and dust. Furthermore, Gram and Huss (1996) observed that *S. aureus* contamination in seafood often originates from food handlers who fail to use gloves or protective gear during preparation. Although *S. aureus* is not of fecal origin, it poses a serious food safety risk because of its ability to produce heat-stable enterotoxins that cause food poisoning even after cooking.

The detection of *Listeria spp*. (9.4%) in seafood samples is particularly concerning due to its psychrotrophic nature, which allows it to grow at refrigeration temperatures. This indicates that contamination likely occurred post-harvest and persisted due to improper temperature control during storage. This observation aligns with the findings of Graves et al. (2010), who reported *Listeria monocytogenes* in seafood from cold storage facilities, emphasizing that poor temperature management can enable bacterial survival. Likewise, Borresen (2008) noted that *Listeria spp*. Contamination in seafood is common when ice or cold storage equipment is reused without sanitization. The occurrence of *Listeria* in the present study suggests that the refrigeration systems used by vendors in Asaba are either inadequate or poorly maintained.

Low-frequency detection of opportunistic and Spoilage Bacteria *Pseudomonas spp*, *Enterobacter cloacae*, and *Proteus spp*. Suggests secondary contamination from environmental sources or storage conditions. *Pseudomonas spp*. are known spoilage organisms that cause off-odour and slime formation in seafood during storage (Gram & Dalgaard, 2002). Their presence indicates that some seafoods were not stored at appropriate temperatures or were kept for extended periods before sale. These findings are consistent with Liu et al. (2020), who demonstrated that *Pseudomonas spp.* Dominate seafood spoilage flora during refrigerated storage. Similarly, *Proteus* and *Enterobacter species* have been associated with decomposition and putrefaction in fish and shellfish (Jay et al., 2005). Biochemical test result confirmed the identity of five major pathogens *Salmonella typhi*, *Escherichia coli*, *Listeria monocytogenes*, *Shigella spp*., and *Staphylococcus aureus*. These organisms are of high public health significance and are known to cause gastroenteritis, food poisoning, and systemic infections. Bacterial load varied across the markets, reflecting differences in environmental cleanliness, water source quality, and seafood handling practices. Markets with heavy human activity and poor drainage (e.g., Ogbeogonogo) showed the highest contamination levels.

The study clearly demonstrates that seafoods sold in Asaba are microbiologically contaminated and thus pose potential health risks to consumers. The detection of enteric pathogens such as *Salmonella*, *E. coli*, and *Shigella* suggests contamination from fecal sources, most likely due to the use of contaminated water during washing or the unhygienic conditions of fish markets.

These findings are consistent with the results of other studies in Nigeri*a*, which also reported *Salmonella* and *E. coli* as dominant bacteria in seafood sold in open markets. The occurrence of *Staphylococcus aureus* points to contamination during handling and processing, as it is commonly found on human skin, nose, and hands. Similarly, the detection of *Listeria monocytogenes* highlights the lack of temperature control, since *Listeria* can survive and multiply even at refrigeration temperatures. The high Total Viable Bacterial Counts further support the evidence of contamination, as most values exceeded recommended limits of 10^5 CFU/g for fresh seafood (ICMSF, 2002). These results confirm that improper hygiene, exposure to ambient temperature, and use of non-potable water are major contributors to seafood contamination in Asaba. Overall, the results emphasize the urgent need for improved sanitation and regulatory oversight of seafood markets to ensure food safety and public health protection.

Conclusion

This study concludes that seafoods marketed in Asaba, Delta State, are highly contaminated with pathogenic and indicator microorganisms. The predominant bacterial species *Salmonella spp, E. coli, Shigella spp, Staphylococcus spp,* and *Listeria spp* are all associated with food-borne diseases, confirming that these seafoods are not microbiologically safe for direct consumption without proper cooking. The observed high bacterial counts and poor sanitary conditions in the markets reflect inadequate hygiene, improper storage, and cross-contamination during handling. If these practices persist, seafood consumption in Asaba may lead to outbreaks of gastroenteritis, typhoid fever, or listeriosis, especially among vulnerable groups such as children and the elderly. Therefore, there is an urgent need for improved food safety standards, vendor education, and environmental sanitation programs in seafood markets across Asaba.

Cite this article as:
Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K. (2026). Microbiological quality of commercially available seafood in Asaba, Delta State, Nigeria. *FNAS Journal of Applied Biological Sciences, 3*(1), 8-15. https://doi.org/10.63561/jabs.v3i1.1172

Recommendations

Based on the findings of this study local government and market authorities should ensure regular cleaning and disinfection of Seafoods stalls to prevent microbial contamination.

1. Vendors need access to clean, potable water for washing and processing seafood, as contaminated water significantly contributes to microbial growth.
2. Seafood handlers and sellers should receive training on essential food safety practices, including proper handwashing, waste management, and the use of clean equipment.
3. Adequate storage facilities, such as ice boxes and cold rooms, should be provided to preserve seafood freshness and reduce bacterial growth.
4. Environmental Health Officers should conduct routine microbiological inspections of seafood in open markets to ensure compliance with public health standards.
5. Consumers should be educated on the importance of thoroughly cooking seafood to eliminate potential pathogens. Regulatory bodies like NAFDAC and the Federal Ministry of Health should enforce stricter seafood hygiene and safety regulations at sales points.

References

Abdollahzadeh, E., Ojagh, S. M., Hosseini, H., Irajian, G., & Ghaemi, E. A. (2016). Prevalence and molecular characterization of *Listeria* spp. and *Listeria monocytogenes* isolated from fish, shrimp, and cooked ready-to-eat (RTE) aquatic products in Iran. *LWT – Food Science and Technology, 73*, 205–211.

Adegoke, A. A., Adebayo-Tayo, C. B., Inyang, U. C., Aiyegoro, A. O., & Komolafe, O. A. (2010). Snails as meat source: Epidemiological and nutritional perspectives. *Journal of Microbiology and Antimicrobials, 2*(1), 1–5.

Ajayi, K. O., & Omoya, F. O. (2017). Molecular identification of selected multiple antibiotic resistance bacteria isolated from poultry droppings in Akure, Nigeria. *Biochemistry and Molecular Biology, 2*(1), 6–11.

Akinnibosun, F. I., & Adeola, M. O. (2015). Quality assessment and proximate analysis of *Amaranthus hybridus, Celosia argentea,* and *Talinum triangulare* obtained from open markets in Benin City, Nigeria. *Journal of Applied Sciences and Environmental Management, 19*(4), 727–734.

Ofesi, A. O., Igere, B. E., Onoriasakpobare, F. O., & Chukwuka, E. G. (2025). Antimicrobial and phytochemical analysis on extracts of *Moringa oleifera* seeds collected at the University of Ilorin Botanical Center, Kwara State, Nigeria. *FUDMA Journal of Sciences, 9*(4), 167–171.

Igere, B. E., Onoriasakpobare, F. O., & Adeola, M. O. (2024). Prevalence of haemolysin-Bl and cytotoxin K toxinigenic *Bacillus cereus* in milk/milk products in Oghara and environs. *Nigerian Journal of Science and Environment, 22*(1).

Borresen, T. (2008). Improving seafood products for the consumer. In *Woodhead Publishing Series in Food Science, Technology and Nutrition* (No. 158). Woodhead Publishing.

Brindha, V., & Ani, A. M. (2012). Molecular characterization and identification of unknown bacteria from wastewater. *Indian Journal of Innovations and Development, 1*(2), 87–91.

Emmett, R., Akkersdyk, S., Yeatman, H., & Meyer, B. J. (2013). Expanding awareness of docosahexaenoic acid during pregnancy. *Nutrients, 5*, 1098–1109.

Eze, V. C., Okoye, C. O., & Chikwendu, C. I. (2021). Microbial contamination of fresh and processed seafood in Nigerian markets. *African Journal of Microbiology Research, 15*(4), 112–119.

Food and Agriculture Organization of the United Nations & World Health Organization. (2020). *Risk assessment of Vibrio parahaemolyticus in seafood*. Food and Agriculture Organization of the United Nations.

Gram, L., & Dalgaard, P. (2002). Fish spoilage bacteria: Problems and solutions. *Current Opinion in Biotechnology, 13*(3), 262–266.

Graves, L. M., Helsel, L. O., Steigerwalt, A. G., Morey, R. E., Daneshvar, M. I., Roof, S. E., Orsi, R. H., Fortes, E. D., Milillo, S. R., den Bakker, H. C., Wiedmann, M., Swaminathan, B., & Sauders, B. D. (2010). *Listeria marthii* sp. nov., isolated from the natural environment, Finger Lakes National Forest. *International Journal of Systematic and Evolutionary Microbiology, 60*, 1280–1288.

Huss, H. H., Ababouch, L., & Gram, L. (2003). *Assessment and management of seafood safety and quality* (FAO Fisheries Technical Paper No. 444). Food and Agriculture Organization of the United Nations.

International Commission on Microbiological Specifications for Foods. (2011). *Microorganisms in foods 8: Use of data for assessing process control and product acceptance*. Springer Science & Business Media.

Iwamoto, M., Ayers, T., Mahon, B. E., & Swerdlow, D. L. (2010). Epidemiology of seafood-associated infections in the United States. *Clinical Microbiology Reviews, 23*, 399–411.

Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). *Modern food microbiology* (7th ed.). Springer.

Onojafe, J. O., Onoriasakpobare, F. O., & Ugegeh, D. O. (2025). Aetiology and severity of diarrhoea among children under five in Uvwie Local Government Area, Delta State, Nigeria. *Faculty of Natural and Applied Sciences Journal of Applied and Physical Sciences, 2*(3), 66–76.

Cite this article as:
Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K. (2026). Microbiological quality of commercially available seafood in Asaba, Delta State, Nigeria. *FNAS Journal of Applied Biological Sciences, 3*(1), 8-15. https://doi.org/10.63561/jabs.v3i1.1172

Lambertz, S. T., Ivarsson, S., Lopez-Valladares, G., Sidstedt, M., & Lindqvist, R. (2013). Subtyping of *Listeria monocytogenes* isolates recovered from retail ready-to-eat foods, processing plants and listeriosis patients in Sweden 2010. *International Journal of Food Microbiology*, *166*, 186–192.

Liu, Y., Yang, S., Li, C., & Liu, X. (2020). Spoilage bacterial community dynamics in chilled seafood using high-throughput sequencing. *Journal of Food Protection*, *83*(6), 1047–1055.

Mahaffey, K. R., Clickner, R. P., & Jeffries, R. A. (2008). Methylmercury and omega-3 fatty acids: Co-occurrence of dietary sources with emphasis on fish and shellfish. *Environmental Research*, *107*, 20–29.

Onoriasakpobare, F. O., Achuba, I., Adeola, M. O., Chike, D. F., Tennyson, E. U., Ofesi, A. O., & Olannye, D. U. (2024). Detection of *Listeria monocytogenes* in raw food and environmental samples in Asaba, Nigeria. *Journal of Agricultural and Food Chemical Engineering*, *4*(3), 1–6.

Obinna-Echem, P. C., & Eze, E. I. (2022). Microbiological quality of seafood in Nigeria: Risks and recommendations. *Nigerian Journal of Food Science and Technology*, *40*(1), 25–33.

Olaoye, O. A., & Onilude, A. A. (2019). Assessment of microbial contamination in seafood: A case study of Nigerian fish markets. *Journal of Food Safety and Hygiene*, *5*(2), 78–85.

Onojafe, J. O., Onoriasakpobare, F. O., & Ugegeh, D. O. (2025). Aetiology and severity of diarrhoea among children under five.

Phan, T. T., Khai, L. T. L., Ogasawara, N., Tam, N. T., Okatani, A. T., Akiba, M., & Hayashidani, H. (2005). Contamination of *Salmonella* in retail meats and shrimps in the Mekong Delta, Vietnam. *Journal of Food Protection*, *68*, 1077–1080.

Wang, F., Jiang, L., Yang, Q., Han, F., Chen, S., Pu, S., Vance, A., & Ge, B. (2011). Prevalence and antimicrobial susceptibility of major foodborne pathogens in imported seafood. *Journal of Food Protection*, *74*, 1451–1461.

Cite this article as:
Onoriasakpobare, F. O., Adeola, M.O., Chukwurah, A.I., & Chukwuji, E.K. (2026). Microbiological quality of commercially available seafood in Asaba, Delta State, Nigeria. *FNAS Journal of Applied Biological Sciences*, *3*(1), 8-15. https://doi.org/10.63561/jabs.v3i1.1172