MICROBIAL LOAD AND ORGANOLEPTIC ASSESSMENT OF CROAKER (*Micropogonias undulatus),* MULLET (*Mugil cephalus)* and SHRIMP (*Pandalus jordani)* FROM COLD STORAGE ROOM IN AKURE AND ONDO METROPOLIS

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ABSTRACT
This study evaluates the microbial load and organoleptic assessment of croaker (Micropogoniu undulates), Mullet (Mugil cephalus) and shrimp (Pandalus jordani) collected from cold storage rooms in Akure and Ondo cities. Samples were collected individually in sterile ice box for two consecutive months. An organoleptic evaluation of the fishes and shrimp samples based on appearance, taste, aroma, texture, and overall acceptability and microbial load were determined using standard methods. The Total Viable Counts (TVC) indicates no significant difference (p > 0.05) in the coliform among the different species and locations. A significant variation (p <. 0.05) was observed in Enterobacteriacea counts among species and locations. The organoleptic assessment of M. undulates, M. cephalus and P. jordani obtained from cold storage room in Ondo city consistently scored higher in appearance, taste, aroma, texture, and overall acceptability compared to M. undulates, M. cephalus and P. jordani obtained from cold storage rooms in Akure city. The results of microbial load and organoleptic assessment observed in this study were below the threshold limits, indicating that consumption of M. undulates, M. cephalus and P. jordani are safe and hazardless from these cold storage rooms in the two cities. However, improvements in hygiene practices, regular testing for microbial loads and flesh quality is recommended to maintain the safety and quality of seafood products.
Keywords: ***Micropogoniu undulates, Mugil cephalus, Pandalus jordani,* Microbial load, Organoleptic assessment**

INTRODUCTION

Fish and shrimp are highly valued food source in Nigeria, prized for its nutritional and health benefits. The country's extensive coastline and continental shelf provide a favourable environment for diverse fish species, making them readily available and affordable in many regions. However, despite abundant natural resources, fish demand consistently outpaces domestic production, leading to the importation of over 800,000 metric tons of fish annually (Federal Bureau of Statistics [FBS], 2017). With a growing population and increasing distances between fish producers and consumers, this import trend is likely to persist, emphasizing the need for efficient fish distribution systems. It is estimated that fish provides 40% of the country's protein intake (Federal Department of Fisheries [FDF], 2017), with an even higher contribution of over 60% in the diets of adults, especially in rural areas (Adekoya & Miller, 2018). Fish is nutritionally superior to other meat sources like beef, mutton, pork, and chicken, offering high-quality protein, easily digestible energy, and essential nutrients such as sulfur and amino acids (Amiengheme, 2017). Additionally, fish is rich in vitamins, including thiamine, vitamins A, D, E, K, and B complex, as well as minerals like calcium and phosphorus.

However, increased urbanization and the growing distance between producers and consumers have made fish marketing increasingly complex. This process encompasses all activities involved in moving fish from the producer to the consumer, including processing, storage, preservation, transportation, wholesale, and retail sales. Maintaining the highest quality and nutritional value of fish throughout the marketing process is crucial. The quality of the processed products largely depends on the quality of raw materials and it is difficult to preserve the freshness of raw materials when there is a long period. Handling of raw materials influences the bacteriological quality of frozen shrimps and fish. Insufficiently iced and improperly storage of shrimps and fish enhances the growth of microorganisms responsible for microbiological changes. Food and Agricultural Organization, FAO (2004), however reported fish quality, including safety as a major concern facing the food industry today. Quality deterioration of stored fish is inevitable with length of storage period (Jeon et al., 2002). Croaker contributes approximately 65% of the total inland fish production in Ondo State. The mullets are also exotic and economically important fresh water fishes in Ondo State. This study evaluates the quality and safety of *M. undulatus, M. cephalus* and *P. jordani* sold in cold storage room in Akure and Ondo Cities.

MATERIALS AND METHODS

Sample Collections

The samples (*M. undulates, M. cephalus and P. jordani*) were collected from cold storage rooms in Akure and Ondo cities, Ondo State individually in sterile polyethylene bags, brought to laboratory of Fisheries and

Aquaculture Technology, Olusegun Agagu University of Science and Technology, Okitipupa under ice-cover and processed within 2 hours. Collection of samples were done for two consecutive months

Organoleptic Assessment

Five (5) trained panellists were constituted for the organoleptic test by using the hedonic scale of 1-7. Score was given to Croaker (*M. undulatus),* Mullet (*M. cephalus)* and Shrimp (*P. jordani)* collected from Akure and Ondo cities with fish samples and shrimp scoring less than 2 regarded as unacceptable. An evaluation was done on appearance (visual appeal of the samples for example colour, freshness, shape), taste (flavour of the fish and shrimp samples), aroma (Smell or scent of the samples before tasting), texture (Mouth feel, including tenderness, juiciness, and firmness) and overall acceptability (Overall sensory impression of the sample, integrating appearance, taste, aroma, and texture). The mean of taste, flavour, aroma, texture, appearance and overall acceptability during this period was calculated and recorded as described by Olusola (2021).

Isolation of Microorganism/Counts

One gram (1g) of each of the *M. undulates, M. cephalus and P. jordani* were aseptically separated, macerated and put into sterile capped test tube containing sterilized peptone water and homogenized (Olusola et al., 2019). Serial dilution was carried out and 1ml each from 10^{-1} to 10^{-6} dilution factors were dispensed into Petri dishes that were appropriately labelled and molten sterile medium was poured aseptically into each Petri dish. The plates were swirled gently for even distribution of inocula and allowed to set /gel and then incubated at 37 ^{0}C for 24-48 hours. The organisms grew into visible different colonies after 24 hours. Total viable counts and Enterobacteriacea counts were determined, the results were expressed in CFU/g.

Statistical Analysis

Data that resulted from the experiments were subjected to descriptive statistics and to a one-way analysis of variance (ANOVA) using SPSS (Statistical Package for Social Science 2006 version 20.0). Duncan's multiple range tests were used to compare the differences among individual means at P= 0.05.

RESULTS

Microbial Loads of *Micropogoniu undulates* and *Mugil cephalus*

The microbial loads of *M. undulates* and *M. cephalus* collected from Akure and Ondo city were assessed by measuring Total Viable Counts (TVC) and Enterobacteriacea counts as presented in Table 1. The TVC indicated that there were no significant differences ($p > 0.05$), in the coliform load among the different species and locations. A significant variation was observed in Enterobacteriacea counts among species and locations. Specifically, the Mullet from Ondo exhibited a significantly lower level of Enterobacteriacea counts (2.85 ± 0.05 CFU/g) compared to Mullet from Akure (3.11 ± 0.09 CFU/g) while Croaker from Akure (2.94 ± 0.08 CFU/g) was relatively similar to Croaker from Ondo (3.00 ± 0.08 CFU/g).

Table 1: The Microbial Loads of *M. undulates and M. cephalus* collected from Akure and Ondo Cities

Species	Croaker Akure	Croaker Ondo	Mullet Akure	Mullet Ondo
Total Viable Counts	3.12±0.05^{a}	3.16±0.04^{a}	3.28±0.12^{a}	3.09±0.04^{a}
Enterobacteriacea counts	2.94±0.08^{a}	3.00±0.08^{a}	3.11±0.09^{b}	2.85±0.05^{a}

Mean (n-2) in each row with similar superscripts are not significantly different (p>0.05)

Organoleptic Assessment *M. undulatus, M. cephalus* and *P. jordani*

The organoleptic assessment as presented in Table 2 revealed that *M. undulatus, M. cephalus* and *P. jordani* samples obtained in cold storage room in Ondo city consistently scored higher in appearance, taste, aroma, texture, and overall acceptability compared to Croaker, Mullet and shrimp samples obtained in cold storage room in Akure

Table 2: Organoleptic Assessment *M. undulatus, M. cephalus* and *P. jordani* collected from Akure and Ondo Cities

Parameter	Croaker Akure	Croaker Ondo	Mullet Akure	Mullet Ondo	Shrimp Akure	Shrimp Ondo
Appearance	5.00±0.00^{a}	5.80±0.45^{b}	4.80±0.45^{a}	5.00±0.71^{a}	4.40±0.55^{a}	4.00±1.41^{a}
Taste	4.20±0.45^{a}	5.00±0.71^{b}	3.80±0.45^{a}	4.60±0.55^{b}	3.60±0.55^{a}	4.20±0.84^{b}
Aroma	4.60±0.55^{a}	4.80±0.45^{a}	4.20±0.45^{a}	4.80±0.45^{a}	3.80±0.84^{a}	4.00±1.22^{a}
Texture	4.20±0.45^{a}	5.00±0.71^{b}	4.80±0.45^{a}	4.80±0.84^{a}	3.60±0.55^{a}	3.60±1.34^{a}
Acceptability	4.20±0.45^{a}	5.00±0.71^{a}	4.80±0.45^{a}	4.80±0.45^{a}	4.20±0.84^{a}	4.20±0.84^{a}

Mean (n-3) in each row with similar superscripts are not significantly different (p>0.05)

DISCUSSION

The microbial load of fish and shrimp samples was assessed to evaluate potential risks to consumers. This assessment are key indicators of microbiological quality and safety. The results show variation across the different species and locations but generally indicate a moderate presence. The Enterobacteriacea counts of the fish samples varied more noticeably. The lower Enterobacteriacea count in Mullet from Ondo suggests that either the environmental conditions in Ondo city are less conducive to the proliferation of Enterobacteriacea counts or that the handling and processing practices in Ondo city are more effective in controlling these bacteria. The higher counts of Enterobacteriacea in Mullet from Akure and Croaker from Ondo may indicate that these locations or species might have different contamination sources or levels of bacterial load. Enterobacteriacea is often associated with fecal contamination, which could imply differences in sanitation practices, or fish handling methods between the locations. The variability in Enterobacteriacea counts observed in this study, reflect findings from similar studies in the field of food microbiology and aquaculture. Gould (2021) demonstrated that fish from areas with poor sanitation and inadequate handling practices had higher levels of Enterobacteriacea counts

This supports the finding that Mullet from Ondo had lower Enterobacteriacea counts, which could be attributed to better environmental conditions because environmental factors and handling practices significantly impact bacterial loads. High TVC levels can indicate poor handling, storage, or processing practices, which could pose a risk to consumer health. However, the TVC values reported in this study are relatively low and suggest that, at least in terms of overall viable counts, the fish are within acceptable limits. The World Health Organization (WHO) indicates that fish products with TVC levels below $\log_{10}$ 6 CFU/g are generally considered safe for consumption (WHO, 2014). The observed values are well below this threshold, implying a relatively lower risk of microbial contamination.

The organoleptic assessment provides insights into consumer preferences regarding fish and shrimp quality focusing on appearance, taste, aroma, texture, and overall acceptability. *Micropogoniu undulates, Mugil cephalus and Pandalus jordani* obtained from cold storage room in Ondo city consistently scored higher across appearance, taste, aroma, texture, and overall acceptability compared to *Micropogoniu undulates, Mugil cephalus and Pandalus jordani* obtained from cold storage room in Akure. This suggests that the fish samples and shrimp obtained in cold storage room in Ondo city was visually appealing, which aligns with findings by Oron & Khalil (2016), who emphasize the significance of visual attractiveness in consumer choice and attributed higher appearance scores to better freshness and handling practices, which enhance consumer appeal. This finding supports the work of Kumar & Singh (2015), who found that overall acceptability is a composite of appearance, taste, aroma, and texture.

CONCLUSION AND RECOMMENDATION

The result of this study revealed that microbial load and organoleptic assessment indicate that *M. undulates, M. cephalus and P. jordani* obtained from cold storage rooms in Ondo and Akure cities were within the acceptable limit for consumption and possess less health risk for human. However, these results suggest that consumer preference is influenced by multiple sensory attributes, with Croaker and mullet obtained from Ondo cities performing particularly well in all assessed categories. Therefore, to ensure the food safety aspects from detrimental consequences of microbial contaminations, execution of standards/permissible limits in water, *M. undulates, M. cephalus and P. jordani* is obligatory.

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