Journal of Fish Health
Volume 4, Issue 1, June 2024
https://doi.org/10.29303/jfh.v4i1.4898

The Abundance of Bacteria Associated with Intertidal Seaweeds *Sargassum* sp. and *Kappaphycus alvare*zii in Ekas Bay

Nuri Muahiddah[1*], Nunik Cokrowati[1], Rangga Idris Affandi[1], Muhammad Junaidi[1], Muhammad Sumsanto[1], Septiana Dwiyanti[1], Yuliana Asri[1], Salnida Yuniarti Lumbessy[1]

[1]Aquaculture Study Program, Faculty of Agriculture, University of Mataram
Pendidikan Street No. 37 Mataram, West Nusa Tenggara

***Correspondence**:
nurimuahiddah@unram.ac.id
Received : 06-10-2024
Accepted : 06-20-2024

Keywords:
Bacteria, Ekas Bay, *Kappaphycus alvarezii*, *Sargassum* sp.

ABSTRACT

This study investigates the abundance and diversity of bacteria associated with two intertidal seaweeds, *Sargassum* sp. and *Kappaphycus alvarezii*, in Ekas Bay. Intertidal zones are dynamic environments where seaweeds and their associated microbial communities play crucial roles in ecological processes. Seaweeds host a variety of bacteria that contribute to nutrient cycling, seaweed health, and overall ecosystem function. The primary variable measured in this study was the bacterial abundance, expressed as Colony Forming Units per milliliter (CFU/mL). The conclusion of these findings has positive implications for the environmental health around the floating raft, base stakes, *Sargassum* sp. and *Kappaphycus alverazii.* The absence of harmful bacteria supports the sustainability of aquatic ecosystems and can provide positive benefits for the species inhabiting those areas.

INTRODUCTION

Intertidal zones are dynamic and highly productive areas where various marine organisms, including seaweeds, interact with a complex array of environmental factors (Teagle *et al*., 2017). Among these organisms, seaweeds play a crucial role in coastal ecosystems, providing habitat, food, and oxygen while also participating in nutrient cycling. *Sargassum* sp. and *Kappaphycus alvarezii* are two notable types of seaweeds found in intertidal zones, known for their ecological and economic importance (Cotas *et al*., 2023). *Sargassum* sp. is widely recognized for its role in coastal protection and as a habitat for marine life (Fidai *et al*., 2020), whereas *Kappaphycus alvarezii* is a commercially valuable species used in carrageenan production (Rupet *et al*., 2022).

Bacteria associated with seaweeds are integral to the health and functionality of these marine plants (Singh & Reddy, 2014). These bacterial communities can influence various physiological processes in seaweeds, such as growth, nutrient acquisition, and defense against pathogens. The study of these microbial communities provides insights into the ecological interactions and overall health of seaweed populations.

Ekas Bay, located on the southeastern coast of Lombok, Indonesia, is a region characterized by rich marine biodiversity and extensive intertidal zones (Setyawidati *et al*., 2018). The bay's unique environmental conditions offer a valuable opportunity to study the

interaction between seaweeds and their associated bacterial communities (Menaa *et al.,* 2020).

This study aims to investigate the abundance and diversity of bacteria associated with *Sargassum* sp. and *Kappaphycus alvarezii* in Ekas Bay. By comparing the bacterial communities on these two seaweeds species, we can better understand the ecological roles of these bacteria and how they contribute to the health and resilience of their seaweed hosts. Specifically, this research seeks to address the following questions: What is the abundance of bacteria associated with *Sargassum* sp. and *Kappaphycus alvarezii* in Ekas Bay?; How do the bacterial communities differ between these two seaweed species?; What are the potential ecological roles of the dominant bacterial species found on these seaweeds?

Through this study, we aim to contribute to the broader understanding of marine microbiology and the symbiotic relationships between seaweeds and their associated bacterial communities. This knowledge is essential for managing and preserving marine ecosystems, particularly in regions like Ekas Bay, where seaweeds play a vital role in maintaining ecological balance and supporting marine life.

METHODS

The research was conducted in December 2023 in the waters of Ekas Bay, located in East Lombok, West Nusa Tenggara, Indonesia (Figure 1).

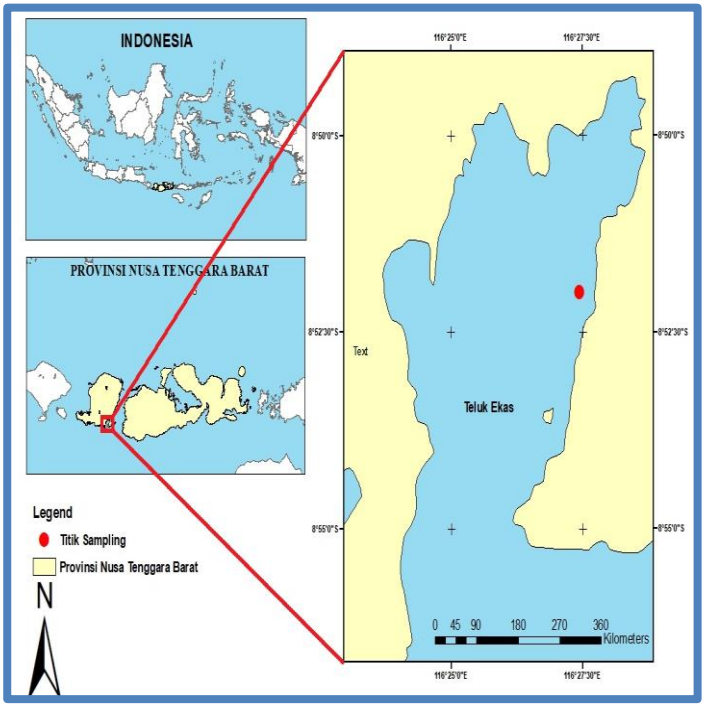

Figure 1. Map of the Waters of Ekas, East Lombok

The study area was selected based on the characteristics of land use in the region, particularly focusing on marine aquaculture activities. These activities have significant impacts on the local marine ecosystem and thus provide a valuable context for studying microbial communities associated with seaweeds. The research was carried out at two distinct stations within Ekas Bay:

Station A: This site is characterized by Floating Raft seaweed aquaculture activities. Floating rafts are used for cultivating seaweeds in the water column, providing a unique habitat for both seaweeds and their associated microbial communities.
Station B: This site involves Basic Stake seaweed aquaculture activities. Basic stakes are fixed structures anchored to the sea floor, which also support seaweed growth and offer different environmental conditions compared to floating rafts.

Samples of water and two types of seaweed, *Sargassum* sp. and *Kappaphycus alvarezii*, were collected from both stations. To ensure the accuracy and reliability of the data, samples of bacteria from the water column and seaweed surfaces were taken in three replications at each station. The average values of these replications were used in the analysis. The consideration behind taking three replications was that the dynamic conditions of the waters in Ekas Bay are relatively stable and do not fluctuate significantly, given that the bay is semi-enclosed. The coordinate positions of the respective sampling locations can be found in Table 1.

The materials used in this study included water and sediment samples from the waters of Ekas Bay. These samples were collected to analyze the microbial communities associated with the seaweeds and the surrounding environment. Data collection was carried out using a purposive sampling method. This method was chosen based on the specific characteristics of water and sediment in Ekas Bay, ensuring that the samples were representative of the study area's conditions. The parameters measured during data collection included: Water Quality**:** Various physical and chemical parameters of the water were measured to assess the overall environmental conditions and their potential impact on microbial communities. Sediment Profile**:** The physical and chemical characteristics of the sediment were analyzed to understand how the substrate might influence bacterial populations.

The primary variable measured in this study was the bacterial abundance, expressed as Colony Forming Units per milliliter (CFU/mL). The analysis of the total bacterial profile in water and seaweed samples was performed using the Total Plate Count (TPC) method, following the guidelines outlined in SNI 7545.1 (2009). The TPC method involves several steps:

1. Sample Dilution: Water and seaweed extract samples were serially diluted to obtain a range of concentrations suitable for plating.
2. Plating on Agar Media: The diluted samples were plated on appropriate agar media to support the growth of bacterial colonies.
3. Incubation: The plates were incubated at a specific temperature for a set period to allow bacterial colonies to grow.
4. Colony Counting: After incubation, the number of colonies on each plate was counted. These counts were used to calculate the bacterial abundance in the original samples, expressed as CFU/mL.

The data obtained from the TPC method were analyzed to determine the total bacterial abundance and distribution associated with *Sargassum* sp. and *Kappaphycus alvarezii* at both research stations. This analysis provided insights into how different aquaculture practices (floating raft vs. basic stake) and environmental conditions affect bacterial communities on these seaweeds. The findings from this study contribute to a better understanding of the microbial ecology in marine aquaculture environments and the potential implications for seaweed health and aquaculture productivity.

RESULTS

Table 1. Gram Positive Bacterial Content in Ekas Bay, East Lombok, West Nusa Tenggara, Indonesia

	Water Bacteria		Seaweed bacteria	
	Floating Raft	Basic Stake	*Sargassum* sp.	*Kappaphycus alvarezii*
Total Plate Gram Positive Bacterial Count CFU/ml	0	0-1x 10^5	1x 10^5	5.1 x 10^6
Total Vibrio Count CFU/ml	1.1 x 10^6	2.07x 10^7	1.1 x 10^6	2.07x 10^7

DISCUSSION

Based on the data results, the number of bacteria in the water around the floating raft and the base stakes does not indicate a dangerous quantity as it is still within the normal range of bacterial counts 0 CFU/ml. Similarly, in the case of *Sargassum* sp. (1 x 10^5 CFU) and *Kappaphycus alverazii* (5.1 x 10^6 CFU) in the water around the cages, there is no harmful amount of bacteria observed based on the bacterial counts. Here's the explanation. The data indicates that the quantity of bacteria around the floating raft and base stakes falls within the normal range. This suggests that the aquatic environment surrounding both structures has not shown a significant increase in bacteria levels that could be considered harmful (Danner *et al*., 2019).

The research findings indicate that there are no bacterial quantities reaching hazardous levels (Total Vibrio Count CFU/ml) around *Sargassum* sp. (1.1 x 10^6 CFU/ml) and *Kappaphycus alverazii* (2.07 x 10^7 CFU/ml) in the cage waters. This suggests that the environment around both types of seaweed tends to be safe from potential health risks caused by pathogenic bacteria (Banach *et al*., 2020). The interpretation of this data remains contingent on the safety standards or environmental guidelines applied. There may be specific standards set by environmental authorities or relevant organizations that need to be considered to ensure that the measured bacteria levels indeed fall within the specified safety limits. Although the current results indicate that the aquatic environment appears to be free from harmful bacteria, it is important to maintain continuous monitoring. Environmental conditions can change over time, and routine monitoring will help detect any potential changes that may occur in the future.

The conclusion of these findings has positive implications for the environmental health around the floating raft, base stakes, *Sargassum* sp. and *Kappaphycus alverazii*. The absence of harmful bacteria supports the sustainability of aquatic ecosystems and can provide positive benefits for the species inhabiting those areas. Thus, these results paint a positive picture of the measured water environment's safety, but it remains important to consider further context and involve experts or environmental authorities to ensure accurate interpretation (Koelmans *et al*., 2019).

CONCLUSION

The abundance of bacteria associated with intertidal seaweeds *Sargassum* sp. and *Kappaphycus alvarezii* in Ekas Bay the bacteria in floating raft and the base stakes does not indicate a dangerous quantity as it is still within the normal range of bacterial counts 0

CFU/ml. Similarly, in the case of *Sargassum* sp. (1 x 10^5 CFU) and *Kappaphycus alverazii* (5.1 x 10^6 CFU) in the water around the cages, there is no harmful amount of bacteria observed based on the bacterial counts. The research findings indicate that there are no bacterial quantities reaching hazardous levels (Total Vibrio Count CFU/ml) around *Sargassum* sp. (1.1 x 10^6 CFU/ml) and *Kappaphycus alverazii* (2.07 x 10^7 CFU/ml) in the cage waters. The conclusion of these findings has positive implications for the environmental health around the floating raft, base stakes, *Sargassum* sp. and *Kappaphycus alverazii*.

ACKNOWLEDGEMENT

Thank you to the University of Mataram for providing the facilities for this research.

REFERENCES

Armstrong, E., Rogerson, A., & Leftley, J. W. (2000). The abundance of heterotrophic protists associated with intertidal seaweeds. *Estuarine, Coastal and Shelf Science*, *50*(3), 415-424.

Banach, J. L., Hoek-van den Hil, E. F., & van der Fels-Klerx, H. J. (2020). Food safety hazards in the European seaweed chain. *Comprehensive reviews in food science and food safety*, *19*(2), 332-364.

Cotas, J., Gomes, L., Pacheco, D., & Pereira, L. (2023). Ecosystem services provided by seaweeds. *Hydrobiology*, *2*(1), 75-96.

Danner, M. C., Robertson, A., Behrends, V., & Reiss, J. (2019). Antibiotic pollution in surface fresh waters: Occurrence and effects. *Science of the total environment*, *664*, 793-804.

Daoden, K., & Kornpitak, T. (2019). Applied Contingency Table with Qualitative Focus Group on Occupational Health and Safety Management Perceptions of Operation and Leader in Medium Construction. *International Journal of Psychosocial Rehabilitation*, *23*(1).

Egan, S., Harder, T., Burke, C., Steinberg, P., Kjelleberg, S., & Thomas, T. (2013). The seaweed holobiont: understanding seaweed–bacteria interactions. *FEMS Microbiology Reviews*, *37*(3), 462-476.

Koelmans, A. A., Nor, N. H. M., Hermsen, E., Kooi, M., Mintenig, S. M., & De France, J. (2019). Microplastics in freshwaters and drinking water: Critical review and assessment of data quality. *Water research*, *155*, 410-422.

Menaa, F., Wijesinghe, P. A. U. I., Thiripuranathar, G., Uzair, B., Iqbal, H., Khan, B. A., & Menaa, B. (2020). Ecological and industrial implications of dynamic seaweed-associated microbiota interactions. *Marine drugs*, *18*(12), 641.

Purnami, P. P. C. P., Indraningrat, A. A. G., & Darmayasa, I. B. G. (2022). Antibacterial Activity Screening of Bacterial Isolates Associated With Seaweed Eucheuma cottonii From Coastal Area In Buleleng, Bali. *Biotropika: Journal of Tropical Biology*, *10*(2), 132-140.

Setyawidati, N. A. R., Puspita, M., Kaimuddin, A. H., Widowati, I., Deslandes, E., Bourgougnon, N., & Stiger-Pouvreau, V. (2018). Seasonal biomass and alginate stock assessment of three abundant genera of brown macroalgae using multispectral high resolution satellite remote sensing: A case study at Ekas Bay (Lombok, Indonesia). *Marine pollution bulletin*, *131*, 40-48.

Singh, R. P., & Reddy, C. R. K. (2014). Seaweed–microbial interactions: key functions of seaweed-associated bacteria. *FEMS microbiology ecology*, *88*(2), 213-230.

Sulardiono, B., A'IN, C. H. U. R. U. N., & MUSKANANFOLA, M. R. (2018). Profiles of water quality

at Menjangan Besar Island, Karimunjawa, Central Java Province, Indonesia. *Biodiversitas Journal of Biological Diversity*, *19*(6), 2308-2315.

Teagle, H., Hawkins, S. J., Moore, P. J., & Smale, D. A. (2017). The role of kelp species as biogenic habitat formers in coastal marine ecosystems. *Journal of Experimental Marine Biology and Ecology*, *492*, 81-98.