

CHAPTER I

INTRODUCTION

1.1 Background

Mangroves are unique ecosystems that straddle land and sea, characterized by high salinity, high temperatures, strong winds and tides, muddy sediments, and anaerobic soils (Arifanti et al., 2022). Mangrove forests have many ecological functions, including physical, biological, and socio-economic, such as protecting coastal areas from tsunamis, coastal erosion, and tidal flooding (Rahmi et al., 2023). Indonesia has the largest mangrove area in the world, covering 3,112,989 ha (22.6% of the world's mangrove area). Mangrove forests are spread across several regions, including Papua, Sulawesi, Sumatra, Kalimantan, and Java (Febrianto et al., 2024). Mangrove in the north coast of Central Java were usually located near settlements and productive activities such as aquaculture, fish product processing industries, and fish landing ports (Subagiyo et al., 2017).

The mangrove areas in Brebes have significant potential for the development of community-managed sustainable ecotourism, where the sustainability of management depends heavily on stakeholder roles and adaptation strategies to the complexity of coastal substrate variations (mud, sand, and sandy mud). This unique ecological condition is reflected in the vegetation structure, where the mangrove communities in both research villages are dominated by adaptive species such as *Rhizophora* sp. and

Avicennia sp. (Christy et al., 2019). Meanwhile, in Demak, mangroves in good condition have been used for coastal protection, mangrove cultivation, and replanting to support fish nurseries and ponds, as well as ecotourism (Sari et al., 2020; Nasution et al., 2024).

The global omega-3 market is estimated to reach USD 2.29 billion by 2025, with an annual growth rate of 7.4%. Omega-3 and omega-6 are increasingly recognized for their essential roles in human nutrition, pharmaceuticals, and various industrial applications (Chauhan et al., 2023). However, the main challenges in the commercial production of omega-3 from marine sources are the rising costs and the potential impact of environmental conditions, particularly marine pollution (Suhendra et al., 2019).

Thraustochytrids hold great promise for biotechnological applications. Thraustochytrids can produce polyunsaturated fatty acids (PUFAs) (e.g., DHA & EPA), enzymes, polysaccharides, and secondary metabolites (Duan et al., 2018). Thraustochytrid growth is relatively rapid due to the accumulation of high levels of squalene and polyunsaturated fatty acids (PUFAs), namely docosahexaenoic acid (DHA) and n-6 docosapentaenoic acid (DPA). Lipids themselves play an essential role as one of the components of the energy flow in aquatic ecological processes. In fish of higher trophic levels, PUFA is one of the most critical nutrients (Ueda et al., 2015). These omega-3 fatty acids can potentially prevent various health problems, including cancer and heart disease (Rollin et al., 2022). While fish oil is often considered less desirable due to its strong aroma and flavor, microbial-derived oils offer better taste and flavor

properties (Gupta et al., 2022). This is particularly important given that the global fish supply cannot meet the annual omega-3 demand of 1.3 million tonnes for the globally recommended consumption level (Finco et al., 2017). Furthermore, microbial oils are ideal for vegan and vegetarian consumers who avoid fish oil for dietary reasons or specific food preferences (Eratte et al., 2018).

Thraustochytrids play a key ecological role as nutrient decomposers in marine and coastal ecosystems. In their natural habitat, thraustochytrids and bacteria are the main remineralisers and decomposers in the food chain of mangrove ecosystems (Morabito et al., 2019). Thraustochytrids are widely distributed in marine and estuarine environments, including standing water, sediments, algae, mangroves, particulate detritus, and invertebrates (Kalidasan et al., 2021b; Suhendra et al., 2021). Exploration of Thraustochytrid diversity from natural habitats is hampered by the ongoing challenge of isolating new strains (Qarri et al., 2024). It is important to increase our knowledge of new cultivable thraustochytrid strains and to develop innovative methods to cultivate thraustochytrids from different natural habitats, both in ecology and biotechnology (Lyu et al., 2021). Many studies have been conducted to isolate new Thraustochytrid strains, assess their diversity across different marine environments, and improve the production of their bioactive compounds. However, no systematic investigation of their cultivable diversity and cultivation techniques has been carried out. Recently, a new approach to isolating and cultivating axenic thraustochytrid cultures from marine

invertebrates has been developed (Qarri et al., 2021). Studying the presence of Thraustochytrids is essential for developing these microorganisms in biotechnology. This research at the University of Diponegoro is important for identifying Thraustochytrids' genetic diversity and calcification, thereby providing a comprehensive understanding of their characteristics. This study focused on different sediment samples collected from Brebes and Demak mangrove forests.

1.2 Problem Statement

1.2.1 Is there any difference in isolated thraustochytrids from mangrove sediments in Brebes and Demak?

1.2.2 What kind of difference is the molecular characterization of thraustochytrids isolated from mangrove sediments in Brebes and Demak?

1.3 Objectives

1.3.1 This research aims to investigate the difference of thraustochytrids present in mangrove sediments from Brebes and Demak.

1.3.2 This research aims to explore the molecular difference of these thraustochytrids to provide a comprehensive understanding of their genetic variations.

1.4 Benefit

This research is expected to inform about the presence and differences of Thraustochytrids from mangrove sediments between Brebes and Demak. It offers insights into the diversity of macroscopic and microscopic characterization results, the presence of lipids in Thraustochytrids, and into the genetic variation observed in the isolated Thraustochytrids.