



Assessment of genetic diversity within euclidean cultivars in east Sabah, Malaysia

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Abstract

Studies have shown that cultivars of the carrageenophytes *Kappaphycus* and *Euclidean* are clones of a limited number of strains originally domesticated from wild populations. For the development and selection of new cultivars, it is important that a comprehensive record of available variants exists. This study was conducted to provide up-to-date analysis and compilation of the current state of cultivars as the last list of cultivars was compiled nearly a decade ago. The present study analyzed the *cox2–3* spacer and *cox1* (1356 bp) genetic diversity of cultivars collected from 2019 to 2020 from the east coast of Sabah where the seaweed farms are concentrated. These data were compared with cultivars reported from 2010 to 2012 to assess changes, if any, to the gene pool of farmed euclidean in Malaysia. *Kappaphycus alvarezii*, *K. striatus*, and *K. malesianus* are currently cultivated while *Euclidean denticulatum* is no longer an important cultivar compared to a decade ago, probably due to its lower price. Analysis of the *cox2–3* spacer revealed a new haplotype, LBT10, and, by including published GenBank data, a further four previously unnamed haplotypes were recognized from Sabah. This study confirms that there is a limited gene pool within cultivars in Malaysia and suggests the need for new or genetically diverse cultivars which can adapt to a changing environment, to ensure a more sustainable carrageenan industry.

Keywords *Kappaphycus* · *Euclidean* · Rhodophyta · Cultivation · Genetic variation · *cox2–3* spacer · *cox1*

Introduction

Kappaphycus and *Euclidean* (herein referred to as euclideanoids) are commercially important red (Rhodophyta) seaweeds valued for carrageenan, a useful phycocolloid especially in the food and cosmetic industries. The increasing demand for carrageenan has spurred on the commercial introduction of these rhodophytes to various parts of the world (Bixler and Porse 2011; FAO 2020; Brakel et al. 2021). In Malaysia, euclideanoids are mainly cultivated on the east coast of Sabah which features long coastlines, extensive continental shelves, clean water, and being distant from estuaries and coral reefs (Sade et al. 2006; FAO 2018). Seaweed farming improves the social-economic conditions of the local coastal communities by offering job opportunities and income. As such, the development of the seaweed industry has always been one of the priority areas for the aquaculture industry, especially in Sabah (Hurtado et al. 2001; Sade et al. 2006; Phang et al. 2010; Nor et al. 2020). However, the cultivation practice in Malaysia has progressed little over the years, with production generally

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