

PROBIOTIC FORTIFIED SEAWEED AS A NEW GENERATION ROTIFER FEED

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SYNOPSIS

Optimization of the probiotic microbes fortified fermentation dynamics of seaweed powder, *Eucheuma denticulatum* and *Kappaphycus alvarezii*, was investigated via microbiology and chemical analysis. A total of seven types of fermentation were carried out for each seaweed using a cocktail of four strains of Lactic Acid Bacteria; *Lactobacillus casei*, *Lactobacillus plantarum*, *Lactobacillus fermentum* & *Lactobacillus sakei*, yeast; *Saccharomyces cerevisiae*, and cellulase enzyme. Research was divided into three phases; Phase I- small-scale fermentation (100ml), Phase II – up-scale fermentation (1 L) and Phase III – 3 L fermentation for seaweed silage biomass production and live rotifer feed assay. Bacteria count and pH profile were recorded for all fermentation. In phase I, chemical analysis were carried out for moisture, ash, lipid and protein. In phase II additional analysis such as fatty acids, amino acids, organic acid and carrageenan size, were carried out. In Phase I, fermentation of both seaweed using *Lactobacillus casei* as a single strain and fermentation using a mixture of all four strains showed promising result. Out of these four fermentation that were up-scaled in Phase II, fermentation of *Eucheuma denticulatum* using *Lactobacillus casei* showed the best result in terms of bacteria count where there was an increment of 275 % in the first three days. The pH profile showed a drop in from 5.3 to 3.5. Lipid content was 1.9 %, protein 18% moisture 97.5% and ash 33.4%. Organic acids analysis indicated that lactic oxalic acid, fumaric acid and maleic acids were produced during fermentation. Carrageenan size analysis showed that carrageenan size was reduced from a size of 800KD to 5KD. Fatty acid analysis revealed the production of saturated fatty acids, mono-unsaturated fatty acids and polyunsaturated fatty acids while amino acid analysis showed a surge in free amino acids in the form of glutamic acid and glycine. The anti-microbial assay showed a 50 % inhibition against twelve species of tested microbes. Biomass production of this fermentation from Phase III was used in the live rotifer feed assay, which saw an increment of 224 % in rotifer density when the rotifers were fed with an equal mixture of *Nannocloropsis* and probiotic fortified seaweed silage.

SINOPSIS

Penambahbaikan dinamik proses fermentasi serbuk rumpailaut, *Eucheuma denticulatum* dan *Kappaphycus alvarezii*, dengan menggunakan mikrob probiotik telah dikaji berdasarkan analisis mikrobiologi dan kimia. Sejumlah tujuh jenis penapaian telah dijalankan untuk setiap alga dengan menggunakan campuran empat spesies bakteria asid laktik; *Lactobacillus casei*, *Lactobacillus plantarum*, *Lactobacillus fermentum* dan *Lactobacillus sakei*; *Saccharomyces cerevisiae* dan enzim cellulase. Kajian dibahagikan kepada tiga fasa; Fasa I – penapaian skala kecil (100ml), Fasa II – penapaian skala besar (1 L) dan Fasa III – penapaian 3 L untuk penghasilan biomas dan bioesei makanan hidup rotifer. Kiraan bakteria dan profil pH telah dipantau untuk semua penapaian. Semasa Fasa I, analisa kimia telah dibuat untuk kelembapan, abu, lipid, dan protein. Manakala, untuk Fasa II pula analisa terhadap asid lemak, asid amino, asid organik dan saiz karaginan telah dilakukan. Berdasarkan keputusan Fasa I, penapaian bagi kedua-dua alga dengan menggunakan *Lactobacillus casei* (tunggal) dan campuran keempat-empat spesies telah menunjukkan keputusan yang menggalakkan. Di Fasa II, penapaian *Eucheuma denticulatum* dengan menggunakan *Lactobacillus casei* telah menunjukkan keputusan yang amat baik dari segi kiraan bakteria dimana terdapat peningkatan sebanyak 275 % dalam tiga hari pertama. Profil pH pula telah menunjukkan penurunan dari 5.3 ke 3.5. Kandungan lipid adalah 1.9 %. protein 18%, kelembapan 97.5% dan abu 33.4%. Analisa asid organik menunjukkan bahawa asid laktik, asid oksalik, asid fumarik, dan asid maliek dihasilkan semasa penapaian. Analisa saiz karaginan menunjukkan bahawa saiz karaginan telah dikurangkan dari 800 KDa ke 80 KDa. Analisa asid lemak pula telah menunjukkan penghasilan asid lemak tepu, asid lemak mono tak tepu dan asid lemak poli tak tepu manakala analisa asid amino mencadangkan kehadiran tinggi asid glutamik dan glisin. Esei anti-mikrob menunjukkan 50 % perencatan terhadap duabelas spesies mikrob yang diuji. Penghasilan biomas bagi penapaian ini dari Fasa III telah digunakan untuk esei hidup makanan rotifer yang telah menunjukkan peningkatan sebanyak 224 % dalam kiraan rotifer apabila rotifer diberi makan dengan campuran sekata *Nannocloropsis* dan “seaweed silage”.