

ABSTRACT

Dunaliella sp. is a type of natural fish feed with high protein content and has strong potential to be used as a dietary supplement in aquaculture. The nutritional composition of *Dunaliella* sp. consists of 57% protein, 32% carbohydrates, and 6% lipids. One of the main challenges in *Dunaliella* sp. production lies in the culture medium, particularly the fertilizer used. Commercial fertilizers commonly applied in microalgae culture are standardized; however, they are relatively expensive and have limited nutrient components, such as enzymes. An alternative solution to this problem is the utilization of liquid organic fertilizer (LOF) derived from skipjack tuna (*Katsuwonus pelamis*) viscera waste. This study aimed to analyze the effect of enzyme activity in liquid organic fertilizer (LOF) made from skipjack tuna viscera waste on the growth of *Dunaliella* sp. Growth parameters observed included protease enzyme activity, daily cell density, peak population, specific growth rate, biomass, nitrate and phosphate uptake, and water quality of the culture medium. The study was conducted from July 26 to August 1, 2025, at the Microalgae Laboratory of the Aquaculture Study Program, Malikussaleh University, along with several supporting laboratories. The research employed an experimental method using a non-factorial Completely Randomized Design (CRD) consisting of four treatments with three replications. The treatments included a control using KW21 fertilizer (1 mL/L) and LOF from skipjack tuna viscera waste at doses of 2.5 mL/L, 5 mL/L, and 7.5 mL/L. The results showed that protease enzyme activity in the LOF ranged from 0.037 to 0.069 U/mL. The LOF treatment at a dose of 7.5 mL/L produced the best growth performance of *Dunaliella* sp., with the highest daily cell density of 1057×10^4 cells/mL, the highest peak population on day 5, a specific growth rate of 0.24 cells/day, and the highest biomass compared to other treatments. Analysis of variance (ANOVA) indicated that the application of LOF derived from skipjack tuna viscera waste had a significant effect on peak population and specific growth rate of *Dunaliella* sp. ($p < 0.05$). Water quality during the experiment remained within the optimal range for *Dunaliella* sp. growth. Based on these findings, it can be concluded that liquid organic fertilizer from skipjack tuna viscera waste has potential as an alternative fertilizer to replace commercial fertilizers in supporting the growth of *Dunaliella* sp.

Keywords : *Dunaliella* sp., enzyme activity, liquid organic fertilizer, microalgae growth, tuna viscera waste.

ABSTRAK

Dunaliella sp. adalah jenis pakan alami ikan yang tinggi protein dan memiliki potensial untuk digunakan sebagai tambahan pakan untuk budidaya ikan. Kandungan nutrisi protein *Dunaliella* sp. sebesar 57%, karbohidrat 32%, dan lemak 6%. Permasalahan kultur yang terjadi pada produksi *Dunaliella* sp. terletak pada media pupuk. Jenis pupuk yang sering digunakan dalam kultur mikroalga adalah pupuk komersil yang sudah distandarkan, namun harga jenis-jenis pupuk ini relatif mahal dan memiliki keterbatasan nutrisi dalam pupuk, seperti enzim. Solusi dari permasalahan ini adalah memanfaatkan pupuk organik cair (POC) yang berasal dari limbah jeroan ikan tongkol. Penelitian ini bertujuan untuk menganalisis pengaruh aktivitas enzim pada pupuk organik cair (POC) limbah jeroan ikan tongkol terhadap pertumbuhan *Dunaliella* sp. Parameter pertumbuhan yang diamati meliputi aktivitas enzim protease, kepadatan harian, puncak populasi, laju pertumbuhan spesifik, biomassa, penyerapan nitrat dan fosfat, serta kualitas air media kultur. Penelitian ini dilaksanakan pada 26 Juli sampai 01 Agustus 2025 di Laboratorium Mikroalga Program Studi Akuakultur Universitas Malikussaleh dan beberapa laboratorium pendukung. Metode yang digunakan adalah metode eksperimental dengan Rancangan Acak Lengkap (RAL) non-faktorial yang terdiri dari empat perlakuan dan tiga ulangan, yaitu kontrol menggunakan pupuk KW21 (1 mL/L) serta POC limbah jeroan ikan tongkol dengan dosis 2,5 mL/L, 5 mL/L, dan 7,5 mL/L. Hasil penelitian menunjukkan bahwa aktivitas enzim protease pada POC jeroan ikan tongkol berkisar antara 0,037–0,069 U/mL. Perlakuan POC dosis 7,5 mL/L memberikan hasil terbaik terhadap pertumbuhan *Dunaliella* sp. dengan kepadatan harian tertinggi sebesar 1057×10^4 sel/mL, puncak populasi tertinggi pada hari ke-5, laju pertumbuhan spesifik sebesar 0,24 sel/hari, serta biomassa tertinggi dibandingkan perlakuan lainnya. Hasil analisis sidik ragam (ANOVA) menunjukkan bahwa pemberian POC limbah jeroan ikan tongkol berpengaruh nyata terhadap puncak populasi dan laju pertumbuhan *Dunaliella* sp. ($p < 0,05$). Kualitas air selama penelitian berada dalam kisaran optimal untuk pertumbuhan *Dunaliella* sp. Berdasarkan hasil penelitian dapat disimpulkan bahwa pupuk organik cair limbah jeroan ikan tongkol berpotensi digunakan sebagai pupuk alternatif pengganti pupuk komersial untuk mendukung pertumbuhan *Dunaliella* sp.

Kata kunci: aktivitas enzim, *Dunaliella* sp., jeroan ikan tongkol, pupuk organik cair, pertumbuhan mikroalga.