

INTISARI

Pengaruh Prebiotik Inulin dan Probiotik *Bacillus*–*Lactococcus* dalam Pakan Terhadap Aktivitas Enzim Pencernaan, Ekspresi Gen, Histologi, dan Pertumbuhan Ikan Nila Merah (*Oreochromis* Sp.)

Penelitian ini bertujuan untuk mengevaluasi pengaruh probiotik lokal yang terdiri atas *Bacillus tropicus* PCP1 dan *Lactococcus garvieae* JAL37, prebiotik inulin, serta kombinasi sinbiotiknya dalam pakan terhadap ekspresi gen, aktivitas enzim pencernaan, struktur histologi usus, dan kinerja pertumbuhan ikan nila hibrida merah (*Oreochromis* sp.). Uji pemberian pakan selama 60 hari dilakukan menggunakan Rancangan Acak Lengkap dengan empat perlakuan pakan, yaitu pakan basal (kontrol), pakan dengan suplementasi inulin (5 g/kg pakan), pakan probiotik yang mengandung *B. tropicus* PCP1 dan *L. garvieae* JAL37 (2×10^7 CFU/g pakan), serta pakan sinbiotik yang mengombinasikan probiotik dan prebiotik, masing-masing dengan tiga ulangan. Analisis statistik dilakukan menggunakan analisis varians satu arah (*one-way* ANOVA) dengan bantuan perangkat lunak IBM SPSS Statistics versi 20 (IBM Corp., Armonk, NY, USA). Perbedaan antar nilai rata-rata dianalisis menggunakan uji jarak berganda Duncan (*Duncan's multiple range test*). Parameter yang diamati meliputi pertumbuhan ikan, histomorfologi, aktivitas enzim protease, dan ekspresi gen usus. Hasil penelitian menunjukkan bahwa suplementasi probiotik, prebiotik, dan atau sinbiotik secara signifikan meningkatkan pertumbuhan, total biomassa ikan, panjang vili usus dan FCR ikan. Perlakuan prebiotik menghasilkan capaian pertumbuhan terbaik diikuti oleh perlakuan sinbiotik dan probiotik. Peningkatan aktivitas protease hanya dicapai pada perlakuan probiotik (tertinggi) dan sinbiotik, sementara peningkatan ekspresi gen *growth hormon* (GH) hanya dicapai oleh perlakuan sinbiotik. Ekspresi gen ghrelin dan gen pengangkut nutrisi di usus sama pada tiap perlakuan. Penelitian ini menyimpulkan bahwa prebiotik paling efektif meningkatkan pertumbuhan ikan dengan memfasilitasi pemanjangan vili yang optimal; sinbiotik meningkatkan pertumbuhan dengan meningkatkan ekspresi gen GH, panjang vili, dan aktivitas protease usus; sedangkan probiotik meningkatkan perkembangan ikan dengan meningkatkan aktivitas protease usus yang optimal dan panjang vili.

Kata kunci: Nila, Probiotik, Prebiotik, Sinbiotik, Kinerja pertumbuhan, Ekspresi gen

ABSTRACT

The Influence of Inulin Prebiotics and a *Bacillus*–*Lactococcus* Probiotic Cocktail in Feed on Intestinal Digestive Enzyme Activity, Gene Expression, Histology, and Growth Performance of Red Tilapia (Nilasa Fish) (*Oreochromis* Sp.)

This study investigated the effects of a local probiotics cocktail of *Bacillus tropicus* PCP1 and *Lactococcus garvieae* JAL37, the prebiotic inulin, and their synbiotic combination in feed on gene expression, digestive enzyme activity, intestinal histology, and growth of red hybrid tilapia (*Oreochromis* sp.). A 60-day feeding trial was conducted using a completely randomised design with four dietary treatments and three replicates, with 50 red hybrid tilapia (*Oreochromis* sp.) juveniles per replicate. Treatments consisted of a basal diet, an inulin-supplemented diet (5 g/kg feed), a probiotic diet containing *B. tropicus* PCP1 and *L. garvieae* JAL37 (2×10^7 CFU/g feed), and a synbiotic diet combining both additives. Growth performance, intestinal histomorphology, protease activity, and gene expression were assessed up to Day 60. The statistical analysis were analyzed by one-way analysis of variance (ANOVA) using one-way analysis of variance (ANOVA) in IBM SPSS Statistics version 20 (IBM Corp., Armonk, NY, USA). The significance of the differences between means was tested by Duncan's multiple range test. The results indicated that administering probiotics, prebiotics, and/or synbiotics significantly improved intestinal villus length, growth, total fish biomass, and feed conversion ratio (FCR). The best growth performance was achieved with prebiotic treatment, followed by synbiotic and probiotic treatment. Only the probiotic and synbiotic therapies enhanced protease activity, while only the synbiotic therapy elevated the expression of the growth hormone (GH) gene. The ghrelin and nutrient transport gene expression in the fish intestines were similar across treatments. This study concluded that prebiotics most effectively promoted fish growth by facilitating optimal villi elongation; synbiotics enhanced growth by increasing intestinal GH gene expression, villus length, and protease activity; while probiotics improved fish growth by increasing villi length and intestinal protease activity.

Keywords: Tilapia, Probiotic, Prebiotic, Synbiotic, Growth performance, Gene expression