

Effects of fermented lemon peel supplementation in diet on growth, immune responses, and intestinal morphology of Asian sea bass, *Lates calcarifer*

ABSTRACT

The main purpose of the agriculture circular economy is waste recycling with the intended goal of economic efficiency and environmental protection. In this study, the potential use of lemon peel, an agricultural waste, as a functional feed additive in aquafeed was evaluated by estimating the effects of fermented lemon peel (FLP) supplementation in diet on the growth, immune responses, and intestinal morphology of Asian sea bass, *Lates calcarifer*. Lemon peel was fermented by *Lactobacillus plantarum*. Basal diet was supplemented with 0%, 1%, 3%, and 5% FLP. Four experimental diets were each fed in triplicate to juvenile Asian sea bass (initial weight: 11.42 ± 0.39 g) in a recirculation rearing system for 8 weeks. Final weight, weight gain, feed intake, and survival were similar ($p > 0.05$) among all dietary treatments. Plasma lysozyme activity was higher in fish fed the diet with 3% FLP than that in fish fed the diet with 5% FLP. Hepatic thiobarbituric acid-reactive substance values were lower in fish fed diets with $\leq 3\%$ FLP than that in fish fed the diet with 5% FLP. Fish fed diets with 1% and 3% FLP showed a tight lamina propria (LP) in microvilli compared with fish fed diets with 0% and 5% FLP. The microvilli area/height ratio was higher in fish fed diets with 0% and 5% FLP than that in fish fed diets with 1% and 3% FLP. The minimum level obtained from the second-order polynomial regression model were 0.26 % for microvilli area and area/height ratio. Results indicate that diets supplemented with 1 %–3 % fermented lemon peel can improve intestinal health for Asian sea bass. However, 5% FLP supplementation may lead to low immune response and high oxidative stress.