

## Cellulose-degrading Bacteria for Increasing Nutritional Value of Fish Feed Based Palm Oil By-Product

Ardiansyah Kurniawan<sup>1</sup> and Asep Awaludin Prihanto<sup>2,3,4\*</sup>

<sup>1</sup>Departement of Aquaculture, University of Bangka Belitung, Bangka Belitung Archipelago, Indonesia

<sup>2</sup>Departement of Fisheries Product Technology, Brawijaya University, Jl. Veteran, Malang, East Java, Indonesia

<sup>3</sup>BIO-SEAFOOD Research Unit, Faculty of Fisheries and Marine Science, Brawijaya University, Jl. Veteran, Malang, East Java, Indonesia

<sup>4</sup>Halal Thoyib Science Center, Brawijaya University, Jl. MT Haryono, Malang, East Java, Indonesia

**\*Corresponding Author:** Asep Awaludin Prihanto, Departement of Fishery Product Technology, University of Brawijaya, Malang, Indonesia.

**Received:** January 03, 2018; **Published:** January 19, 2019

Cellulose is the most common organic polymer, especially in the tropic regions. At the molecular level, cellulose composes a linear polymer of glucose. It is not only a problem but also challenges. Cellulose needs biodegradation before using an energy source of glucose. Some agricultural by-product compound crude protein with cellulose. Vegetal protein of agricultural waste can substitute marine animal protein for fish feed with cheaper price. Agricultural waste with the potential for protein content and cellulose is waste of the palm oil industry, especially in palm kernels flour.

Palm kernels flour is a by-product from palm kernel oil extraction. It has 2.5 million tons potential production at 2019 in Indonesia and has 15 - 22% crude protein. This by-product can be used as a substitute for up to 20% soybean meal and fish meal (as a source of dietary protein) in herbivore freshwater fish without negatively affecting the performance of growth and efficiency of feed utilization. The high substitution of the main dietary protein (fish meal) can reduce the fish weight due to fiber digestion time in an intestine. Fish growth has a greater difference in the weight than lengthened. This indicates a decrease in the amount of protein in the energy cycle which causes a lack of residual energy for the formation of new cells and tissues.

Utilization of palm kernel flour as raw material for freshwater fish feed produces a half price of the common commercial fish feed. Percentage of palm kernel composition should be increased to cut the price of feed. Fermentation with cellulolytic bacteria can increase the sugar and crude protein levels, degrade cellulose and crude fiber content. Hence, it will increase the nutrient absorption of feed made from palm kernel flour. Biodegradation of cellulose using cellulolytic bacteria can be an effective way of serving low price of high-quality feed.

Cellulolytic bacteria synthesize a set of enzymes capable of breaking down cellulose by hydrolyzing the glycosides  $\beta$ -1.4 polymer cellulose bond. The presence of cellulose triggers the production of cellulose-degrading enzyme by microorganism. Compared to fungal, the production of cellulose-degrading enzymes by bacteria is faster with shorter production time. Bacteria also produce small enzymes molecules which makes it easier to diffuse on cellulose plant tissue.

Mangroves ecosystem accounted as a reservoir of cellulolytic bacteria. Cellulolytic bacteria was abundantly found in leaf litter, weathered wood, and mangrove sediments. The higher density of mangroves, the more dominant the cellulolytic bacteria in it. Almost all bacteria from mangrove sediment had high cellulose degradation capacity. *Bacillus alvei*, *Bacillus coagulan*, *Bacillus subtilis*, *Bacillus pumilus*, *Pseudomonas putida*, *Bacillus amyloliquefacien*, *Staphylococcus saproviticus*, and *Bacillus cereus* are several species of cellulolytic bacteria were isolated from mangrove Ecosystem on Bangka Island, Indonesia.

Prior to being applied in aquaculture, deep investigation such as pathogenesis test is crucial. Cellulolytic bacterial isolates that are non-pathogenic in freshwater aquaculture fish indicate it safety to be applied as fish feed. Pathogenesis investigation on *Bacillus* sp. which was isolated from mangrove leaf litter showed no significant difference with untreated Nile tilapia (*Oreochromis niloticus*) and Catfish (*Clarias gariepinus*). In all test using Nile tilapia and Catfish resulted in nil mortality.

Fermented palm kernel has a protein digestibility value of  $67.26 \pm 1.71\%$  in its application for tilapia. This application is better than using palm kernel without bioprocessing. The protein digestibility can increase the amount of protein in the fish's energy cycle so that it provides enough left over for heavy growth. This is the answer to the challenge of replacing fish meal as protein sources for fish feed, especially freshwater fish. Fish meal substitution with fermented palm kernel flour has been succeeded to some extent.

Our group has developed fish feed by exploring palm oil by product and the potency of cellulose-producing bacteria. Our preliminary research revealed that fish flour could be partly substituted with fermented palm kernel by-product with acceptable effect on the growth performance of Nile tilapia fish. Our next target is investigating the chosen cellulolytic bacteria for its ability to support probiotic-like effects. Cellulose-degrading bacteria with similar characteristics with probiotic bacteria will be interesting bacterial isolates for fish feed development.

**Volume 15 Issue 2 February 2019**

**© All rights reserved by Hacı Kemal Erdemli.**