



Investigación e Innovación en Nutrición Acuícola

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**Review of Bacterial and Yeast Base Single Cell Protein Ingredients as
Attractants and Fish Meal Replacements in Diets
for *Litopenaeus vannamei***

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Fishmeal (FM) is extensively used as an ingredient in aquafeeds as an attractant and a major source of protein, resulting in an exploitation of natural fisheries to the level that they are not sustainable nor healthy. Global FM harvest has remained at 4.6 to 6 million metric tons/year for the last 10 years while world aquaculture production has increased from 52.5 million metric tons to 82.1 million metric tons from 2008 to 2018. Of this total amount, marine shrimp accounted for over five million metric tons in 2018. Over 80% of global commercial production of marine shrimp for human consumption use Pacific white shrimp, *Litopenaeus vannamei*. This has stimulated increased research for fishmeal replacement (FMR) using plant, fishery, confectionary, corn and sugar cane from the ethanol production industry, etc. products and by-products. The most promising FMR ingredients are single cell proteins (SCP) using bacteria, yeast and microalgae as sources. This is a review of our research using bacterial and yeast based SCP ingredients as attractants and FMR in diets for *L. vannamei*. Our FMR research used materials and methods developed by Texas A&M University System, University of Alabama at Birmingham and University of Sonora using laboratory facilities and clear water RAS which will be summarized in the presentation.

Summary of results of our FMR research using bacterial and yeast based SCP are as follows:

- SCP has potential of reducing dietary protein requirement in commercial shrimp feeds to less than 20% protein.
- SCP has potential of reducing dietary vitamin, zinc and copper requirements to less than 50% of dietary requirement for these nutrients in the absence of SCP.
- About 30% FMR using either yeast or bacterial based SCP significantly increases growth to over 2.5 gms/week and decreases FCR to less than 1.8 as compared to control diet

containing 21.4% FM giving growth of about 2.2 gms/week and a FCR of about 2.7 for conditions of this research using clear water RAS.

- About 80% FMR using bacterial based SCP significantly increases growth to over 2.5 g/week and decreases FCR to less than 1.8 as compared to control diet containing 21.4% FM giving growth of about 2.2 g/week and a FCR of about 2.7 for conditions of this research using clear water RAS.
- The final shrimp weight of the 30% and 80% FMR experiments using SCP was over 20 grams with an average survival of over 95%.
- 100% FMR using a SCP containing 90% bacterial base and 10% yeast base SCP resulted in a significant increase in growth of about 2.35 g/week as compared to a growth of about 2.05 g/week for shrimp fed a commercial diet containing 21.4% FM.
- 100% FMR using a SCP containing 90% bacterial base and 10% yeast base SCP resulted in an increase in growth of about 2.35 g/week as compared to a growth of about 2.25 g/week for shrimp fed a commercial diet containing a FMR of a diet containing 100% bacterial based SCP.
- 100% FMR diets containing a mixture of 20% FM, 10% yeast base SCP and 70% bacterial base SCP, and 10% FM and 90% bacterial base SCP, and 100% bacterial based SCP resulted in shrimp tail muscle weight of about 8 g for shrimp having an average final weight of about 16 g as compared to shrimp tail weights of about 6.4 g for shrimp having a final weight of about 14.5 g fed a control diet with 0% SCP and 21.4% FM.
- Attractability of bacterial base SCP is greater than yeast base SCP; attractability of a diet containing 3% bacterial base SCP or squid meal is significantly greater than a diet containing 3% FM. Attractability of diets with about 30% FMR with yeast base and bacterial base SCP is significantly greater than a commercial diet containing 21.4% FM.

In conclusion, we have been successful for 100% FMR by SCP in shrimp diets and (1) a mixture of 10% yeast base and 90% bacterial base SCP 100% FMR results in greater growth than bacterial base SCP 100% FMR and (2) increase in growth performance with 100% FMR can in part be explained by an increase in attractability, and unknown chemoattractants, nucleotides, non-essential amino acids, dipeptides, bioamines, growth factors, etc.

Keywords: Bacteria, yeast, *single cell proteins*, *attractants*, *fish meal replacement*, *shrimp feeds*