Contents lists available at ScienceDirect

Aquaculture

journal homepage: www.elsevier.com/locate/aquaculture

Interactive effects of dietary phosphorus and microbial phytase on growth performance, intestinal morphometry, and welfare of Nile tilapia (*Oreochromis niloticus*) fed on low-fishmeal diets

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ARTICLE INFO

Keywords:
Microbial phytase
Dietary phosphorus
Nile tilapia
Growth performance
Antioxidant and immune indices
Intestinal morphometry

ABSTRACT

One of the industries with the fastest growth rates in the world is aquaculture. However, as fish meal (FM), the most expensive component of aquafeeds, is increasingly replaced with plant protein, the amount of phosphorus (P) in fish diets decreases as a result of plant proteins' high phytate content, which chelates P. Inorganic P is a dietary supplement that increases fish development and feed utilization, but its high inclusion in aquafeeds causes eutrophication due to environmental contamination. Consuming dietary phytase can make more P available, which lowers the amount of inorganic P in fish diets. The present study assessed the effects of replacing inorganic P in Nile tilapia (*O. niloticus*) diets with a hybrid microbial phytase (HMPhyt) derived from bacteria hybrid (*Buttiauxella gaviniae*, *Yersinia mollaretii*, and *Hafnia* sp.) on growth and welfare. Fish (1.50 ± 0.16 g) were divided into 18,100-L tanks with 20 fish each, and they were fed one of six low FM diets that were both isonitrogenous (300 g/kg) and isocalorific (17 kJ/g). The control diet had no P or HMPhyt supplements (0P + 0HMPhyt), the second diet contained 0.2 g/kg (1000FTU/kg) HMPhyt only (0P + HMPhyt), the third diet contained 100% P (13.0 g/kg) only (100P + 0HMPhyt), and the fourth to the six diets contained 75% (9.8 g/kg) P (75P + HMPhyt), 50% (6.5 g/kg) P (50P + HMPhyt), or 25% (3.3 g/kg) P (25P + HMPhyt). Fish were fed the experimental diets three times each day for 56 days, until they appeared satisfied. In comparison to the control diet (0P + HMPhyt), the results reveal that dietary phytase and/or inorganic P significantly increased Nile tilapia growth indices and feed intake ($P < 0.05$) than the control group. In contrast, there were no differences in the feed conversion ratio or the percentage of fish that survived among the various fish groups ($P > 0.05$). In addition, fish fed on P and/or HMPhyt containing diets had significantly greater counts of red and white blood cells, packed cell volume, and hemoglobin, as well as higher intestinal villi width/height, and absorption area compared to the control group. In contrast, higher levels of alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, and malondialdehyde were found in fish fed the control diet (0P + HMPhyt), while higher levels of superoxide dismutase, catalase, lysozyme, and respiratory burst activity were found in fish fed the inorganic P and/or HMPhyt based diets As a result, dietary HMPhyt (1000 FTU/kg) can totally substitute inorganic P in Nile tilapia diets without having any negative impacts on the fish's welfare or growth.

1. Introduction

digestibility, and palatability, is typically utilized as a significant protein