



Dietary phosphorus requirement of large yellow croaker, *Pseudosciaena crocea* R[☆]

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Abstract

A study was conducted to estimate the optimum requirement of dietary phosphorus for large yellow croaker in floating sea cages (1.0 × 1.0 × 1.5 m). Five practical diets were formulated to contain graded levels (0.30%, 0.55%, 0.69%, 0.91% and 1.16%) of available phosphorus from dietary ingredients and monocalcium phosphate (MCP). Each diet was randomly assigned to triplicate groups of 180 juvenile fish (initial body weight, 1.88 ± 0.02 g). Fish were fed twice daily (5:00 and 17:00) to satiation for 8 weeks. During the experimental period, the water temperature fluctuated from 26.5 to 32.5 °C, salinity from 32‰ to 36‰ and dissolved oxygen was more than 7 mg l⁻¹. Specific growth rate (SGR) significantly increased with increasing available phosphorus from 0.30% to 0.69% of diet ($P < 0.05$), and then leveled off. The body composition analysis showed that the whole-body ash and lipid, as well as phosphorus content in the whole body, vertebrae and scales were significantly affected by dietary available phosphorus level ($P < 0.05$). Broken-line analysis based on SGR indicated the minimum available phosphorus requirement for the optimal growth of large yellow croaker was 0.70%. Based on the phosphorus content in either vertebrae or whole body, the requirements were 0.89% and 0.91%, respectively.

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Keywords: Fish; Large yellow croaker; *Pseudosciaena crocea*; Phosphorus requirement; Feeding and nutrition

1. Introduction

Phosphorus is one of the most important minerals that required by fish (Lall, 2002). It is a major constituent of skeletal tissue and involved in a variety of metabolic processes including energy transformations, permeability of cellular membranes, and genetic coding (Lovell, 1989).

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Fish can absorb minerals from natural water (NRC, 1993). However, due to low concentration of phosphorus in natural waters (Boyd, 1971), and low absorption rate of phosphorus from the water (Phillips et al., 1958), fish must obtain most of phosphorus from their diets. The optimal amount of phosphorus supplementation in commercial feeds is not only important economically, but also for environmental reasons. The phosphorus excreted from cultured animals into water contributes to algal growth, and results in deteriorating water quality (Beveridge, 1984; Auer et al., 1986). Phosphorus metabolism in cultured aquatic species has become a popular research subject, due to rising concerns about phosphorus discharged into aquaculture environment (Wiesmann et al., 1988; Ketola and Harland, 1993).

Large yellow croaker is one of commercially important marine fish in China, and has been widely cultured in recent years. Trash fish is main food for large yellow croaker cultured in the sea cages in China, which is difficult to store, easy to deteriorate water quality and may result in the spread of diseases. Recently, due to the shortage of fishery resources, available trash fish could not meet the demand for the expanding farming of this fish in China. Therefore, commercial feeds for large yellow croaker are demanded to produce maximum growth of fish and protect water quality. Although specific nutrient requirements of large yellow croaker have recently been investigated (Duan et al., 2001), dietary mineral requirements have not been reported for this fish. The objective of this study was to determine the phosphorus requirement of large yellow croaker fed with practical diet under sea cage conditions.

2. Materials and methods

2.1. Experimental diets

Five experimental diets were formulated from practical ingredients and monocalcium phosphate (MCP) to contain graded levels (0.61%, 0.86%, 1.01%, 1.25% and 1.49%) of total phosphorus. The corresponding available phosphorus levels in diets were 0.30%, 0.55%, 0.69%, 0.91% and 1.16%, respectively (Table 1), calculated on the basis of the apparent phosphorus digestibility determined in this

study. The contents of protein and lipid in all diets were designed to be about 43% and 12%, respectively, which are considered to be sufficient to support optimal growth of this fish (Duan et al., 2001).

Fish meal was sieved through an 800 μm mesh to remove part of fish bone, and then ingredients were ground into fine powder through 220 μm mesh. All the ingredients were thoroughly mixed with fish oil, and water was added to produce stiff dough. The dough was then pelleted with an experimental feed mill (F-26 (II), South China University of Technology, China) and dried for about 12 h in a ventilated oven at 60 °C. After drying, the diets were broken up and sieved into proper pellet sizes (1.5 \times 2.0 and 2.5 \times 3.0 mm). All diets were sealed in bags and stored at –15 °C until used. Additionally, a portion from either Diet 1 (the basal diet) or Diet 3 (added 1.51% MCP) was supplemented with 0.1% of chromic oxide (Cr_2O_3) as an inert digestion marker to determine phosphorus digestibility.

2.2. Experimental procedure

The feeding trial was conducted at XIHU bay of Ningbo, Zhejiang province, China. Large yellow croaker (*Pseudosciaena crocea*) juveniles obtained from a commercial hatchery, were stocked into sea cages (3.0 \times 3.0 \times 3.0 m) and conditioned for a 2-week period by feeding the basal diet twice daily to satiation. At the start of the feeding trial, the fish were starved for 24 h, and then weighed after being anesthetized with eugenol (1 : 10000) (Shanghai Reagent Corp, China). The fish with the similar size (mean initial weight 1.88 ± 0.02 g) were distributed to 15 sea cages (1.0 \times 1.0 \times 1.5 m) at density of 180 fish per cage. Each diet was fed to triplicate groups of fish twice daily (05:00 and 17:00) to apparent satiation, on the basis of feeding behavior observation for 8 weeks. During the experimental period the water temperature ranged from 26.5 to 32.5 °C, salinity from 32‰ to 36‰, and dissolved oxygen was higher than 7 mg l^{-1} . Fish were reared under natural light conditions throughout the experiment.

To determine the phosphorus availability from either the basal diet or MCP, two extra cages (1.5 \times 1.5 \times 2.0 m) of fish (200 fish per cage, mean initial body weight 15.0 ± 0.6 g) were fed parts of either Diets 1 or 3, which contained 0.1% Cr_2O_3 ,

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