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Effects of dietary vitamin C supplementation on fingerling golden trevally, *Gnathanodon speciosus* (Carangidae)

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Abstract

This purpose of this experiment was to test the influence of vitamin C on golden trevally, *Gnathanodon speciosus*. Three levels of vitamin C (100, 200 and 300 mg kg⁻¹ diet) were added to the basal diet (use as control diet) and fed the fish (initial weight 3.52 g ± 0.11 (SEM) for 8 weeks. Growth performance and tissue protein were measured. The result showed that growth rate of fish enhanced significantly with the present of vitamin C in their diet ($P < 0.05$). Survival rate significantly increased in fish fed diets with 200 mg vitamin C compared to control. Protein in the flesh of fish were 18.06 to 19.53%, but protein content did not influence by vitamin C. The concentration of 200 mg vitamin C kg⁻¹ is recommended to supplement to the feed of golden trevally for better growth and survival. In conclusion, supplemented vitamin C in diet benefits for boosting growth, survival and body composition of this species at juvenile stage.

Keywords: golden trevally, *Gnathanodon speciosus*, vitamin C, growth, body composition

1. Introduction

The golden trevally (*Gnathanodon speciosus*) are reef-dwelling marine species distributed in the tropical and subtropical waters of the Eastern Pacific, Western Indo-Pacific and Eastern and Western Atlantic Ocean. The Golden Trevally is a popular food, and ornamental fish native to the tropical Indo-Pacific region. In Vietnam this species has been induced spawning successfully is a new candidate for aquaculture. The golden trevally is a very important cultured species in Vietnam, due to its fast growth, high market value, desirable taste and recent supply shortage. However, the species faces great challenges due to the environmental stressors found on aquaculture farms, including water pollution, high stocking density, and low water quality.

Vitamin C (ascorbic acid) is a water-soluble antioxidant and has been long considered to be a health-promoting agent when applied in aquaculture [1-5]. Vitamin C has a distinct role as a cofactor for enzymes engaged in hydroxylation of proline and lysine, and is required for synthesis of collagen and construction of bone matrix [6]. In several fish species, dietary vitamin C required for maximum body growth exceeds the basic requirement levels for growth, survival and hydroxyproline concentrations [7]. Furthermore, immune response indicators are stimulated by vitamin C levels far above the physiological body necessities, protecting fish against stress as well [7, 8].

There are many studies on effects of vitamin C on aquatic species, however, to the authors' knowledge, effects of vitamin C growth of golden trevally, is still poorly understood. Inclusion dosage of the feed additives a vital role because inappropriate dose may adversely affect the animals [9, 10]. Therefore, the present study aimed to define the optimal range of vitamin C inclusion in diets on growth performance and protein content of golden trevally, *Gnathanodon speciosus*.

2. Materials and Methods

2.1 Experimental fish and culture systems

The golden trevally, *Gnathanodon speciosus* was obtained from a hatchery in Nha Trang, Vietnam. A total of 320 fish from the same broodstock with mean initial wet weight 3.52 g ± 0.11 (SEM) were randomly stocked in 16 tanks composite tanks.

2.2 Experimental design

The experiment tested the growth response and mortality of fish fed basal diet added with Vitamin C for 8 weeks. A design was used in which the four dietary treatments were randomly allocated to 4 replicate tanks, each with twenty animals in each tank. A total of 16 tanks and 320 fingerling golden trevally were stocked.

2.3 Experimental diets and feeding

Three levels (with 100, 200 and 300 mg kg⁻¹ diet) of vitamin C were added to a basal diet (content 39.3% crude protein, 8.71% lipid and 19.72 GE MJ/kg). Experimental fish were fed 5% of the average biomass in each tank on the first day, and then every day the amount fed was adjusted, based on the amount of uneaten or remaining pellets. Rations were offered to the fish twice daily (1/2 at 08:00 and the remaining 1/2 at 17:00). Uneaten feed and feces were siphoned daily before morning feed. These procedures were followed for 8 weeks.

2.4 Sampling and data collection

All the fish were weighed and total length was measured at beginning and end of the experiment. At the end of the experiment, one fish from each cage (6 animals in each treatment) was randomly sampled and sacrificed for measurement of muscle composition. Fish were starved for 24 h prior to measuring or sampling.

2.5 Chemical analysis of culture fish

At the end of the experiment (week 8) Muscles of six fish in each treatment were sampled then stored at -20 °C for protein analysis at the end. Crude protein was measured following the Kjeldahl standard method, with the procedure was described

by Do-Huu and Jones ^[10].

2.6 Data calculation

Growth rate, daily growth coefficient (DGC, % d⁻¹) and survival were computed by following equations ^[11]: DGC (% d⁻¹) = 100 x (W_t^{1/3} - W₀^{1/3})/days; Survival rate = 100 x (N_t)/N₀, where W_t and W₀ were weight of fish at the end (week 8) and initial weight (g), respectively. N₀ was the initial number of fish and N_t was the number of fish at the end of the experiment. Coefficient of Variation (CV, %) were calculated as follow: CV = (100 x S/M, where: S was standard deviation, M was mean weight of fish.

2.8 Statistical analysis

Data are presented as means ± standard error (SEM). To compare growth performance and body composition data of fish among diet treatments, ANOVA tests and least significant difference (LSD) were used. Differences were significant when P < 0.05. Non-parametric Kruskal-Wallis test was used to compare survival rate. All statistical analysis were performed in SPSS 18 (IBM, Chicago, IL).

3. Results

3.1 Growth performance of golden trevally fed different levels of vitamin C

The weight of fish at the experiment start was uniform among the treatments, 3.52 g ± 0.11 (SEM). There was no significant difference in average weight of fish between treatments at commencement (ANOVA, P ≥ 0.621). However, significant differences of fish weight among diets were detected at the end of the trial (week 8).

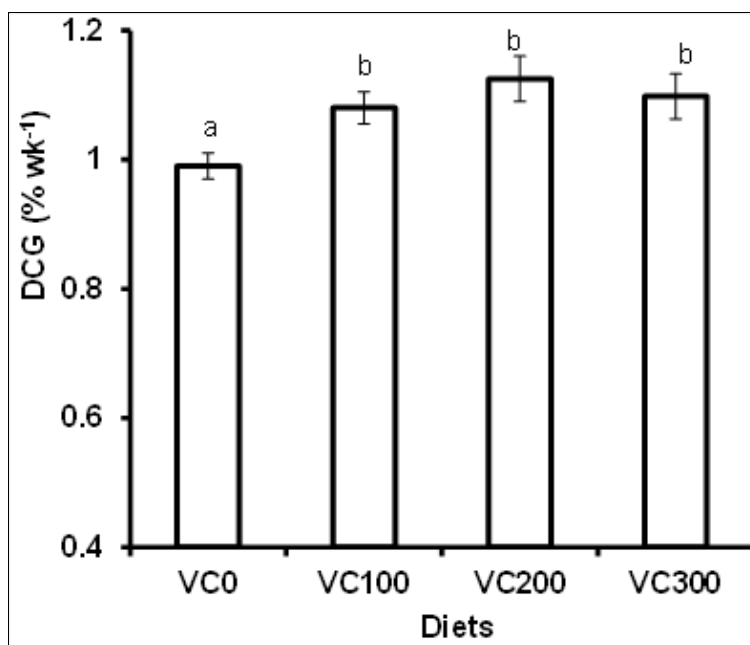


Fig 1: Average daily growth coefficient (DGC, % d⁻¹) (± SEM) of golden trevally fed different levels of vitamin C. Different letters indicate significant differences between treatments.

At the end of the experiment (week 8), fish fed with vitamin C diets showed better growth rate. Mean weight ranged from 6.01 to 8.12 g. The greatest increase in weight was in fish fed 200 mg vitamin C, followed by fish fed diet with 100 and 300 mg vitamin C, but no significant difference between them (P = 0.412). The weight of fish in the three vitamin diets were significantly higher than those fish fed the control diet (P ≤

0.001). (Figure 1).

3.2 Survival rate

At the end of the experiment (week 8), survival rates of fish ranged from 81.60 – 93.60% (Figure 2). The highest survival rates were in golden trevally fed diets 200 mg vitamin C (93.60%). The survival rate of this groups of fish were

significantly higher than those fish fed the control ($P \leq 0.02$). The lowest survival rates were for fish fed control diet, which 81.60%. There was no significant difference between the survival rates of fish fed diets added with 100 or 300 mg vitamin C ($P \geq 0.732$). Also, no significance was found between the survival rates of fish fed and levels of vitamin C ($P \geq 0.362$).

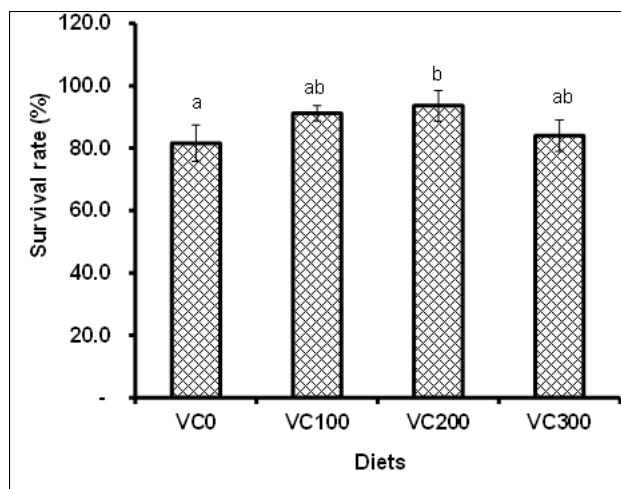


Fig 2: Survival rate of golden trevally fed different levels of vitamin C. Different letters indicate significant differences between treatments.

3.3. Size variation of golden trevally fed different diets

Our results revealed that variation coefficient (CV, %) of body weight of golden trevally was the highest in the fish fed control diet (11.33%). The CV reduced to the lowest value of 7.31% in the group of fish fed diet added with 200 mg C kg⁻¹diet.

There was significant difference in CV value between fish fed diet 200 mg vitamin C compared to fish fed control diet ($P = 0.021$). However, the CV value in fish fed other level of vitamin C did not differ significantly compared to CV in the control group ($P \geq 0.329$).

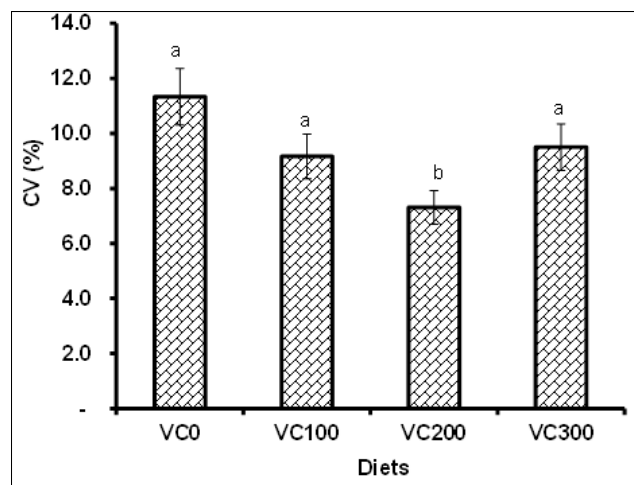


Fig 3: Coefficient of variations in weight (CV, %) of golden trevally fed different levels of vitamin C. Different letters indicate significant differences between treatments.

3.4 Protein content in flesh of golden trevally fed different levels of vitamin C

Our results revealed that protein content in the muscle of golden trevally ranged from 18.06% in the group fed the control to 19.53% in the group fed diet 200 mg C per kilogram diet. There was no significant difference in protein content of fish fed the different diets ($P \geq 0.06$). (Figure 4).

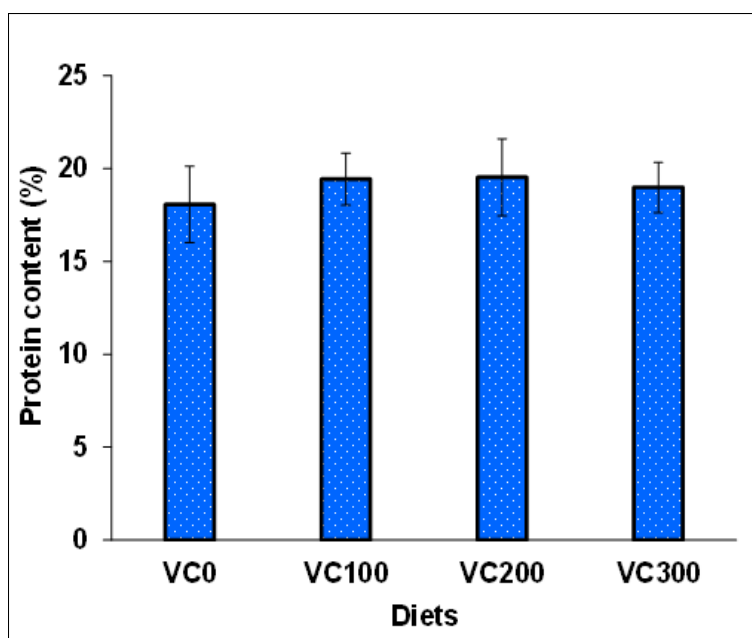


Fig 4: Protein content in the flesh of golden trevally fed different levels of vitamin C. Different letters indicate significant differences between treatments.

4. Discussion

We report the effects of dietary vitamin C on growth and body composition of golden trevally for the first time. This study emphasized the benefit of vitamin C inclusion in the diet to growth and survival of golden trevally, *Gnathanodon*

speciosus. Growth of fish were boosted when they were fed diets with 200 mg vitamin C inclusion in one kilogram diet. This was in agreement with other studies that reported the important role of vitamin C on boosting growth and survival of in juvenile rainbow trout (*Oncorhynchus mykiss*)^[6]; red

sea bream, *Pagrus major* [12] *Heterobranchus longifilis* fingerlings [5]. However, vitamin C supplemented in the diet did not improve growth in juvenile cobia (*Rachycentron canadum*) [4]. The benefit of vitamin C added to the diet may be species-specific.

In the present study, there is no significant difference in the protein content of golden trevally fed different concentration of vitamin C. Our results are similar to Zhou, Wang [4], who reported that that protein content in juvenile cobia (*Rachycentron canadum*) was not influenced by the present of vitamin C added to the diet. In another finding, Ibiyo, Madu [5] stated that the protein content in *Heterobranchus longifilis* fingerlings fed vitamin C did not differ in comparison the fish fed control diet, but the feed utilization in the case of protein efficiency ratio was significantly improved in fish fed vitamin C.

The feed trial reported here has confirmed that the inclusion of vitamin C in diets improves high growth, survival rates of golden trevally, *Gnathanodon speciosus*. The recommendation level of dietary vitamin C for better growth of this species was 200 mg kg⁻¹. Further research also needed to determine vitamin C concentration to optimize growth of golden trevally exposed to various environmental conditions and stressors as well as the physiological and immunological responses of golden trevally. It is also recommended that the effects of dietary vitamin C on different life stages should be examined. In conclusion, dietary vitamin C could enhance growth, survival and body composition of juvenile golden trevally. It is suggested that adding a level of 200 mg vitamin C kg⁻¹ to achieve better growth and reduce mortality of this species at juvenile stage.

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