EFFECTS OF VITAMIN C SUPPLEMENTATION ON GROWTH PERFORMANCE OF GOLDFISH (*CARASSIUS AURATUS*)

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Abstract

Vitamins are essential nutrients found in foods. They perform specific and vital functions in a variety of body systems and these are crucial for maintaining optimal health. This study evaluated the influence of diets supplemented with 0, 900 and 1800 mg vit C/kg feed on the perfomance growth of goldfish fed for 310 days. Fish weight was determinated at the beginning of the experiment and there using the same method, fish weight was observed every month after fish stocking. All the feeds were dispensed twice daily at the rate at 10% of their body weight and decreased progressively with increasing body weight. Results revealed that the growth (in terms of net weight gain and specific growth rate) and dietary utilisation (in terms of feed conversion ratio and protein retention efficiency) were observed to be better in V_2 and V_3 variants which contained 900 and 1800 mg vit C/kg feed describing the role of a vit C in the diet for growth and feed utilisation. Lowest growth and dietary utilisation was observed in variant withouth vitamin C suplemmentation.

Key words: goldfish, growth performance, vitamin C, aquariums

INTRODUCTION

Ornamental fish culture is an important primary industry [4]. Aquarium fishes are rapidly gaining importance not only because of their aesthetic value but also due to their immense commercial value in the export trade all over the world.

Among ornamental fishes, goldfish, *Carassius auratus* (Linnaeus, 1758) of the *Cyprinidae* family remained popular [6]. The goldfish (*Carrassius auratus*) belongs to the family *Cyprinidae* and is the most popular variety of ornamental fish. It was one of the earliest fish to be domesticated, and is one of the most commonly kept aquarium fish [2]. It is very attractive because of their colour and movement. It is also to keep and breed, not only but also inexpensive and very hardy fish.

Some of trace elements and vitamins have been linked with fish growth. Vitamin C is considered to be an essential component in diets for teleost fish [1].

MATERIAL AND METHODS

The study was conducted for 310 days in aquariums at the Aquaculture Department from Faculty of Food Science and Engineering „Dunarea de Jos" University of Galati. The biological material was represented of goldfish with 3 month age and initial average weight of 1,12 g. The fish were divided into three major treatment grops for feeding with vitamin C at different levels such as Control (V_1 variant), 900 and 1800 mg kg-^{1} diet (V_3 variant). Fifteen fish were kept in each aquarium containing 58 l static water. The tanks were drained twice a week and replenished with fresh water to remove accumulated feces from the bottom.

All the feeds were dispensed twice daily at the rate at 10% of their body weight and decreased progressively with increasing body weight. The weight of individual fish in aquarium of each treatment group was recorded on every month and then the total biomass in the tank was determined to adjust the amount of feed to be given.

We used a commercial diet without vit. C in Control variant, which was supplemented with 900 and 1800 mg vitamin C/kg in other

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variants (variant 2 and 3 respectively). In all variants the fish were fed with Nutra 3 pellets (Italy). The pellets contain fish meal, fish oil, vital wheat gluten, wheat, maize gluten. Nutrient compositions of experimental diet are given in Table 1.

Table 1 Biochemical composition of pellets

Biochemical composition	UM	Value
Crude protein	%	55
Crude oils and fats	%	16
Crude fibre	%	1
Moisture content	%	9.5
A vitamin	U.I./kg	6000
D3 vitamin	U.I./kg	1125

For the preparation of vitamin C containing diet, vitamin C tablets were collected from the local market and weighed. Weight of each tablet was 0.6 g and each tablet contains 180 mg vit. C. Working protocol of incorporation Vitamin C in feed following these steps:

1. Dissolution of Vitamin C in gelatin solution 2%;
2. Uniformly spraying the final solution on the surface of feed grains by continuous agitation;
3. Drying the pellets at T^o=25^{o}C for 2 h.

Diets were prepared every fortnight and stored in a refrigerator to minimize nutrient loss.

Somatic measurements were made on the beginning and on the end of the trial at 310 fish/experimental variant determining full length -LT (cm)- and body mass - W (g). Correlation between length and body weight was made by using Microsoft Office Excel 2010 - POWER method.

At the end of the experiment, after all fish were weighed and measured, the following technological efficiency indicators were calculated: growth rate, food conversion ratio, specific growth rate and the protein efficiency ratio using the following equations:

Weight gain (W) = Final weight (W_t) – Initial weight (W_0) (g)

Food conversion ratio (FCR) = Total feed (F) / Total weight gain (W) (g/g)

Specific growth rate (SGR) = 100 x (ln W_t - ln W_0) / t (% BW/day)

Protein efficiency ratio (PER) = Total weight gain (W) / amount of protein fed (P) (g)

RESULTS AND DISSCUSIONS

Vitamin C is shown to be necessary for growth, reproduction and immune response. The major reason for the positive effect of ascorbic acid on growth is due to important role in collagen formation, which is necessary for normal growth.

The results presented in this study also indicated the beneficial effects of dietary ascorbic acid level on growth of goldfish. Vitamin C requirements may depend on various factors such as fish species, size, age, growth rate, stage of sexual maturity, type of diet, processing and storage time of the diet as well as environmental toxicants [1]. Moreover, exact vitamin C requirement also depends on interactions between ascorbic acid and other nutrients.

The quantitative requirements on vitamin C have been determined for several species and the recommended values varied by various studies. James R. and J. Vasudhevan were studied for a period of 120 days the effect of different levels of dietary vitamin C (0, 50, 100, 200 and 300 mg kg diet-1) on the growth, gonad weight, fecundity and leucocytes counts in goldfish and found that 200 mg vit. C. / kg feed can be considered as optimal for growth, reproduction and immune response in goldfish [3].

In the present paper, we had study the effect of 900 and 1800 mg vit C/kg feed on growth in the goldfish, *Carassius auratus*. In all aquariums, the fish appeared healthy and no mortality was observed. Water quality parameters were acceptable range for fish culture in all conditions. For our experiment, the growth indicators of the experimental fish are summarized in Table 2.

Growth Performance: Out of growth performance parameters for trial groups of golfish, the best weight growth as of the completion of the experimental period was attained V_3 variants, where the level of vitamin C was 1800 mg/kg diet. These variant were followed by V_2 and V_1 variant (Table 2).

Table 2 Technological indicators of growth

Parameter/Variant	V1	V2	V3
Initial total biomass (g)	19.57	18.51	17.44
Final total biomass (g)	310.97	323.16	368.52
Initial no. exp.	15	15	15
Final no. exp.	15	15	15
Initial mean body weight (g)	1.3	0.9	1.16
Final mean body weight (g)	20.73	21.54	24.57
Total increase growth (g)	291.4	304.65	351.08
Individual spore growth (g)	19.42	20.31	23.40
FCR	2.5	2.2	2.0
SGR (%/zi)	0.89	0.92	0.98
Protein Efficacy Rate	0.7	0.85	0.9

Feed Conversion Rate: When the rates of feed assessment calculated through the amount of feed consumed and live weight, the best feed assessment rates are observed in V_3 variant, where the level of vitamin C was 1800 mg/kg diet respectively. These variant were followed by V_2 and V_1 variant (Table 2).

Specific growth rate: In aquaculture, several models applicable to the concave portion of the growth curve have been used.

The formula most commonly used is the ″instantaneous growth rate″ or ″specific growth rate″ (SGR) and is based on the natural logarithm of body weight.

The highest specific growth rate was recorded V_3, the percentage rise in the daily growth rate compared with the increase in the 0.98 % / day, whereas for the other values was 0.92% / day (V_2) and 0.89 % / day (V_3).

Protein Efficacy Rate: When the protein efficacy rate is examined in general terms as of the date of completion of the tests, the highest protein efficacy was observed in V_3 variant, where the concentration of vitamin C was 1800 mg/kg diet. This is variant was followed by V_2 and V_3 variants (Table 2).

To calculate food rations is necessary to know the relationship between the nutritional requirements of fish and environmental conditions. In this experiment, the amount of feed distributed was limited by the absence of an efficient water filtration system.

By applying the formula $W=a\ TL^b$ it was determined the correlation between body mass (g) and total length (cm) (W – TL), both at the beginning and at the end of experiment.

Generally, the index "b" values range between 1 and 3, mostly 2 and reflect the state of biological material in environmental conditions [5].

In Figures 1, 2 and 3 is presented the correlation between length and individual average weight, where it can be observed a proportional dependence, revealing more homogeneous population at the end of the experiment than at its beginnings.

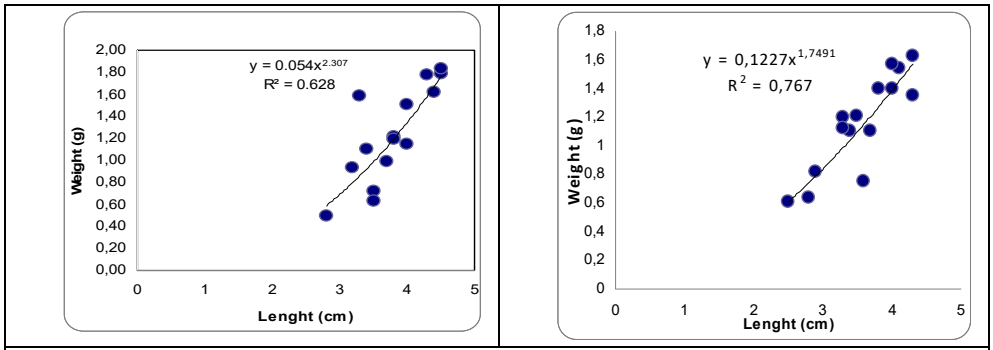
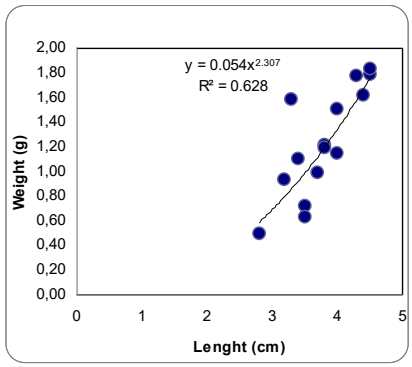


Fig. 1. Length - weight regression of goldfish from V_1 variant



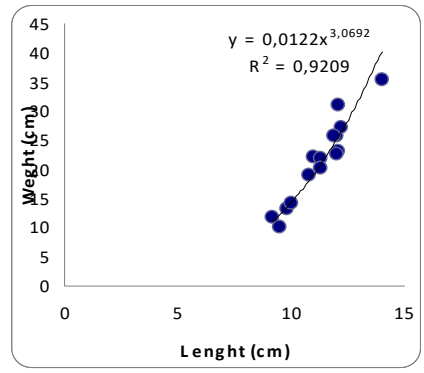
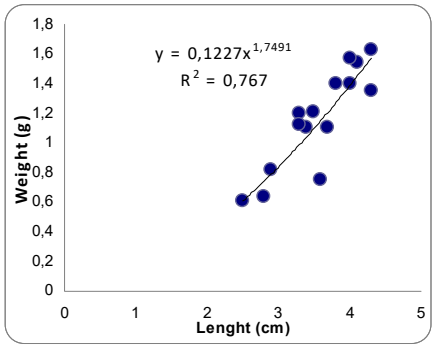


Fig. 2. Length - weight regression of goldfish from V_2 variant



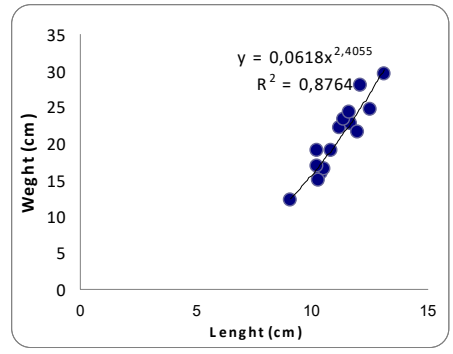


Fig. 3. Length - weight regression of goldfish from V_1 variant

CONCLUSIONS

1. Results revealed that the growth (in terms of net weight gain and specific growth rate) and dietary utilisation (in terms of feed conversion ratio and protein retention efficiency) were observed to be better in V_2 and V_3 variants which contained 900 and 1800 mg vit C/kg feed describing the role of a vit C in the diet for growth and feed utilisation.

2. Excess Vitamin C in fish diet may be wasteful and cause the diets to be unnecessarily expensive.

3. We recommend checking the assimilation of vitamin C in feed by High-performance liquid chromatography *(*HPLC).

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