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Evaluations of the Effects of Different Dietary Vitamin C levels on the Body Composition, Growth Performance and Feed Utilization Efficiencies in Stinging Catfish, *Heteropneustes fossilis* (Bloch, 1792)

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Abstract:

To evaluate the effects of Vitamin C of formulated feed on growth performance, feed utilization efficiency and body composition of shing fish, *Heteropneustes fossilis* (Bloch, 1792) an experiment was conducted for sixty days in nine plastic tanks. During the rearing and feeding trial in the laboratory condition, the change in growth and feed utilization by the shing fish fed on three different Vitamin C level have been assessed by the determination of condition factor (K), survival rate (SR), specific growth rate (SGR%), feed conversion ratio (FCR), feed efficiency and average daily gain (ADG) and protein efficiency ratio (PER). All the water quality parameters specifically- Temperature (^{0}C), Dissolved oxygen (DO), Carbon dioxide (CO_2) and pH in the plastic tanks were highly monitored and maintained. The highest FCR was found in the control while the lowest was measured in treatment 2. The values of PER for treatment 2 was higher than control and treatment 1. The condition factor was highest in treatment 2 but not significantly mentionable with others. The feed efficiency is higher in control and declined gradually between treatment 1 and treatment 2. The value of Average daily gain (ADG) was highest in treatment 2 and lowest in control. The values of SGR% were highest for treatment 2 and lowest for control. Result of the current study showed that supplementation of Vitamin C at 1200 mg/kg feed had significant positive effects on the FCR, SGR, ADG, PER, FE while no such differences were observed in condition factor variables. The fish Diet C containing 1200 mg/ kg of Vitamin C level has been found to be more effective for better growth of the shing fish.[Journal of American Science 2009:5(3) 31-40] (ISSN: 1545-1003)

Key words: Stinging Cat fish, Vitamin C, Body Composition, Growth Performance and Feed Utilization Efficiencies

1. Introduction

In Bangladesh air breathing fishes are very popular in the food menu and have become an economically important group of fishes. Among them *H. fossilis* is most important and can be easily cultured. For the very efficient air breathing organ the survival rate of this fish is high. This also helps the fish to grow abundantly in oxygen depleted water, even in shallow mini ponds. It is easy to keep them alive for longer period in captivity and also transport them alive in semi-dry containers. Sometimes doctors suggest the patients of anemia to have large amount of *H. fossilis* in their food menu [Bhatt, 1968]. Induced spawning and fry production of *H. fossilis* is easy [Ramswamy and sunderaraj, 1956, Thakur *et al*., 1974]. As this fish contains very high protein, high iron and low fat content [Singa kohli, 1979] propagation and culture of

this fish is very important. *Heteropneustes fossilis* has several common names like Asian stinging cat fish or Fossil cat but in our country this fish is locally called Shing fish. In many Asian countries this fish is commercially as well as aquaculturally an important species [Akand *et al*., 1989]. It is an indigenous species to Indo-Pak-Bangladesh sub-continent. This cat fish used to belong to the family Heteropneustidae for many years but very recently it has been moved into the Clariidae family [Diogo *et al.*, 2003]. For high nutritious value, taste and flavor *H. fossilis* has a high market value and consumer preference. Specific nutrition levels play a very important role in fish growth, body composition, feed utilization efficiency and reproduction. Feed is the main factor responsible for affecting growth, spawning success, body composition, and survival of fry including the survival of the brood [De Silva and Perera, 1985]. In commercial catfish feeds the energy ratio ranges from 66-74 k.cal / kg for each 0.05% of Vitamin [Lovell, R.T. 1972]. Proper food selection is important both from nutritional and economical point of view.

A food particle should deliver the necessary nutrients and in a form that can easily be consumed by the fish which will result in more efficient production and increased profits. Food quality, food type and foods cost should be of primary consideration in terms of selecting the best food. A mixture of ingredients is necessary to provide a balance of required nutrients. Any fish cultured with artificial feeds needs a suitable percentage of vitamins in the diet for fast growth and better reproductive performance. However requirement of vitamin C by a particular species of fish varies from others. Vitamin C is considered to be a very important component in the diet of fish especially for the air breathing fish. It has been established that vitamin C is required by all animals for body maintenance, growth and other biological performance, and the vitamin C level needed for these functions varies with the species and culture environment [Delong *et al.,* 1958, Lovell, 1972]. For fish, the optimum amounts of vitamin C in formulated feeds are important because either low or high levels of vitamin may lead to poor growth. As well, excess Vitamin C in fish diet may be wasteful and cause the diets to be unnecessarily expensive. Therefore the present study attempts to investigate the requirement of optimum vitamin C level in formulated fish feed for *H. fossilis*. For carrying out feeding trial under laboratory conditions, rearing facilities were created and *H. fossilis* has been selected as the experimental fish. The overall objective of this study was to improve the feed quality and their effects on the seed quality in Asian stinging cat fish management in Bangladesh. The specific objectives are- to study (a) the effects of dietary vitamin C on growth (b) the impact of dietary vitamin C on the body composition and (c) the impact of dietary vitamin C on the feed utilization efficiencies of *H. fossilis.*

2. Materials and methods

2.1 Description of the Experimental Site

The set up for the experiment was in the Fish Technology Research Laboratory of IFST, BCSIR, Dhaka and Department of Fisheries, University of Dhaka. The experiment consisted of various steps in an organized sequence. These steps included collection of feed ingredients, preparation of fish feed, collection of experimental fish (*H. fossilis*) specimen, acclimatization of the fishes in the laboratory's experimental conditions followed by feeding trials of the fish using the formulated feed in

nine different tanks located in the aquatic laboratory of Fisheries Department, University of Dhaka. The Stinging catfish (*H. fossilis*) were collected before, during and after the feeding trials for analytical purpose as well as measuring the biological parameters required for growth performance.

2.2 Experimental design

The experiment was designed for nurturing stinging cat fish (H. *fossilis)* in nine different plastic tanks each measuring 750L. The tanks were located in the aquatic laboratory of Fisheries Department; University of Dhaka. The water contents of the tanks were supplied through tap by PVC pipes. The *H. fossilis* fish were grouped according to length and weight and then released in the nine tanks. They were given the formulated feed twice a day at different time intervals and every week they were measured for their biological parameters. The collection and analysis of these information gathered using the experimental design mentioned above helped evaluate the growth performance, feed efficiency FCR, PER etc of the specimen.

2.3 Collection of feed ingredients and Feed preparation

Locally available feed ingredients were collected from the fish feed market and also prepared feed specifically for shing fish was collected directly from the feed manufacturing company. The feed ingredients were brought to the Fish Technology Laboratory, IFST, BCSIR, Dhaka to be prepared for the experiment. The collected feed ingredients were mixed thoroughly with a measured amount of hot distilled water to make the mixer moist. Then it was passed through a fish feed pellet-making machine. The fish feed pellets were collected and dried in the sun and then further dried in an oven. After preparation and drying of the pellet was completed they were stored properly for later use in the feeding trials of the *H. fossilis* fish.

2.4 Proximate composition of the feed and Fish

Three types of food pellets were prepared for the *H. fossilis* fish and they were marked as Diet A, B & C depend on Vitamin C Level-0 as Control; 800 and 1200 mg/kg as treatment 1 and treatment 2 respectively. The proximate compositions of each of the feed were carried out in accordance with A.O.A.C method (1990). Proximate composition of the *H. fossilis* fishes was recorded at the initial stage and after 15 days (before different feeding trail) of the experiment according to standard A.O.A.C methods (1990). At the end of the 60-day trial another set of similar analysis were carried out.

2.5 Collection and Feeding trial of fish

Specimen of the experimental fishes (*H. fossils*) was collected from a local market in Dhaka city. The collected fish were reserved in an aluminum container and were brought to the experimental site for carrying out the investigation. After preparation of the experimental tanks, collection of *H. fossilis* fish specimen, collection and preparation of the fish feed pellet, the feeding trials started. According to the size and weight of the fishes an appropriate amount of fish feed were provided two times a day in the experimental tanks. The fishes were divided in three groups and each batch was given a specific category of fish feed at different time intervals with different Vitamin C level. The weight and length of each fish was recorded to evaluate the biological parameters. The survival rate of the fishes was also recorded.

A standard amount of fish feed was given (5% of body weight). Fish bodies were analyzed at the initial and final period of the experiment for assessment of their biochemical composition. These aspects were carefully recorded to investigate if there was any change in the biochemical composition with the advancement of growth.

2.6 Fish stocking in tank and Rate of water supply

There were nine tanks in total, each containing 750L of tap water. 25 fishes were placed in each tank; each of the fish had an average length of 9.2-10.8cm and average weight of 7.4-9.2g, recorded at the initial period of the experiment. Tanks were filled with fresh water from Laboratory water tap through PVC pipes. Water flow rate in the tank maintained as 1 L/ m. Water aerators were fitted in the tanks for proper aeration. To ensure water quality and safety of the fish *H. fossilis* the water of the tanks were changed once a day during the experimental period (60 days).

2.7 Fish sampling procedure and Analysis of experimental data

Sampling was done at an interval of 15, 30 and 60 days of the experimental period. Prior to the experiment, the fishes were captured with a fine mesh scoop net and their individual length and weight were recorded to the closest centimeter and closest gram. After 60 days, at the termination of the experiment, the final length (cm) and weight (g) of each individual fish was carefully recorded. A steel measuring scale was employed for measuring the lengths. A sensitive electronic balance was used to determine the total body weight of individual fish. Experimental data collected during the trial were used to determine the Survival Rate (SR), Condition factor (K), Average Daily Gain (ADG), Specific Growth Rate (SGR %), Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and Feed Efficiency (FE) by using some scientific formulas.

2.8 Water quality analysis

Water quality parameters of the experimental tanks were recorded throughout the study period (60 days) Physico-chemical parameters, such as water temperature (^{0}C), dissolved oxygen (mg/L), pH, nitrate-nitrogen (mg\L), nitrate-nitrogen (mg\L), ammonia-nitrogen (mg\L) etc were closely monitored. Everyday the temperature (^{0}C) of tank water was recorded with the help of a thermometer. pH was determined immediately by a portable pH meter. Dissolved oxygen (DO), carbon dioxide ($C0_2$), hardness, chloride, alkalinity, nitrate-nitrogen ($N0_3$-N), nitrite-nitrogen ($N0_2$-N) and ammonia-nitrogen (NH_3-N) were measured by HACH kit with different HACH program in each sampling date.

3. Results and discussions:

The Study had three aspects: body composition, feed utilization efficiencies and growth performances of stinging cat fish (*Heteropneustes fossilis*). Detailed result of the study on the proximate composition of fish, survival rate, growth performance and water quality parameters reared in nine tanks fed on three formulated diet (Diet A; without Vitamin C, Diet B; 800 mg of Vitamin C per kg of feed and Diet C; 1200 mg of Vitamin C per kg of feed) as recorded during the period of investigation were presented below-

3.1 Proximate composition of fish

During the rearing and feeding trial, investigations were carried out on the proximate composition of *H. fossilis* for several times. According to the size and age of the fish, proximate composition showed variations for giving different Vitamin C level in the formulated feed. After using the formulated feed with different Vitamin C level, protein, fat, ash and moisture contents of the fish showed differences. Fish kept at nine tanks which are treated 15 days with control feed for being them adapt. Moisture, protein, fat, and ash contents were found 79.21%, 16.53%, 2.47%, and 2.25% at the initial period of the experiment. At the Mid of the rearing and feeding trials (30days) when fish is treated with three different diet the moisture, protein, fat and ash contents of the fish ranged from 78.99-79.21%, 16.03-17.05%, 2.37-2.47% and 2.05-2.49% respectively .

At the last of the rearing and feeding period (60days) the moisture, protein, fat and ash contents of the fish ranged from 78.28-78.98, 16.77-17.12%, 2.44-2.60%, and 2.18-2.40% respectively.

From the result it is clearly revealed that the protein content increased; moisture contents decreased and fat and ash contents fluctuated at the time of rearing and feeding trial.

3.2 Survival rate

As the experimental fish has accessory respiratory organ the survival rate of this fish is high in comparison with other fishes. At the time of experiment (rearing fish in the plastic tank which having tap water) the survival rate is comparatively lower than the natural water body as the tap water contained a little bit higher iron (Fe) amount than need. The survival rate of the fish was determined at every 15 days of experimental period. Among nine tanks the survival rate of fish was almost same. At the end of 60 days survival rate of fish was ranging from 80.00-84.00%, 80.00-84.00% and 80.00% in tank A, B & C. These findings have similarities with the findings of Akand and Haque (1989). Their study had 82 to 93% survival rate of the fish during the feeding trial.

3.3 Feed conversion ratio (FCR, %)

The Feed conversion ratio of *H. fossilis* kept in different tanks and fed on three different types of feed have been calculated in every 15, 30 and 60 days study period . The highest FCR (3.33±0.10 %) was found in the control (Diet A) while the lowest (FCR 1.56±0.10 %) was measured in treatment 2 (Diet C). In treatment 1 (Diet B) the value of FCR was 1.97±0.85 % which is significantly higher than treatment 2 but lower than control.

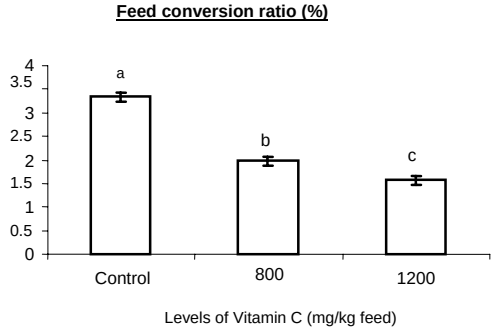

Fig 1: Food conversion ratio (FCR) of pellet feed supplemented with and without Vitamin C fed by *H. fossilis* measured in a laboratory experiment. Bars (mean ±SEM) different letters indicate significant difference.

The lower the FCR the better the feed conversion to fish flesh. From this point of view the formulated feed C gives the best result in comparison with the formulated feed A & B. Finding FCR in the experiment is ranging from 1.8-3.0 which is almost same with the FCR value of *H. fossilis* founded Akand *et.al*.

3.4 Protein efficiency ratio (PER, %)

The values of protein efficiency ratio of the experimental fish *H. fossilis* rearing in nine tanks fed on three different types of fish feed have been estimated at the end of 15, 30 and 60 days study period. The values of PER for treatment 2 was 1.74±0.10 % which is higher than control and treatment 1. PER of treatment 1(1.21±0.51 %) was significantly higher than control (0.76±0.023). From these findings Diet C (1200mg/kg Vitamin C) have shown better protein efficiency ratio than Diet B (800mg/kg Vitamin C) and Diet A (Control feed).

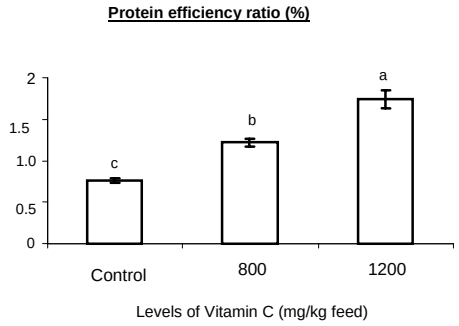

Fig 2: Protein efficiency ratio (PER) of pellet feed supplemented with and without Vitamin C fed by *H. fossilis* observed in a laboratory trail. Bars (mean ±SEM) different letters indicate significant difference.

Mustafa *et al.* (1995) in a study with formulated fish diet observed protein efficiency ratio ranged from 1.31-1.60. Akand and Haque (1989) found 1.32-1.70 during the feeding trial with formulated fish diet which is not similar with our findings. But Doolgindachabaporn, (1994) found that the value of protein efficiency ratio ranges from (0.9-2.1) this finding has more or less similar with us.

3.5 Condition factor (K)

The values of condition factor were calculated during the study period specifically at the end of 15, 30 and 60 days. The condition factor was highest in treatment 2 (1.14± 0.10 %). However the condition factor (1.10±0.02 %) in the treatment 1 was more or less similar with treatment 2 and control (1.06±0.02 %). The values of condition factor of the fish ranged from 0.99-1.19. This finding has got similarities with those of Saha *et al.*(1998) who also got this values of condition factor as nearer to one in case of *Clarias batrachus* [Linnaeus, 1758] fed on formulated diets. In the study on the survival and growth of catfish after giving selected supplemental feeds got the values of condition factor between 0.81-0.87 [Rahman *et al* ,1997], this value also coincides with our condition factor value.

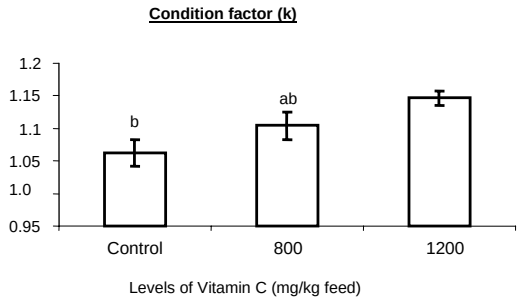

Fig 3: Condition factor (k) in *H. fossilis* determined after 60 days trail feed with different Vitamin C level diet. Bars (mean ±SEM) different letters indicate significant difference.

3.6 Feed efficiency (%)

The values of Feed efficiency ranges have been calculated carefully at the end of 15, 30 and 60 days study period. Usually no significant difference of feed efficiency found in control, treatment 1 and 2. The feed efficiency is higher (50.15±4.28 %) in control and declined gradually

between treatment 1(47.93±5.33 %) and treatment2 (43.23±4.50 %).

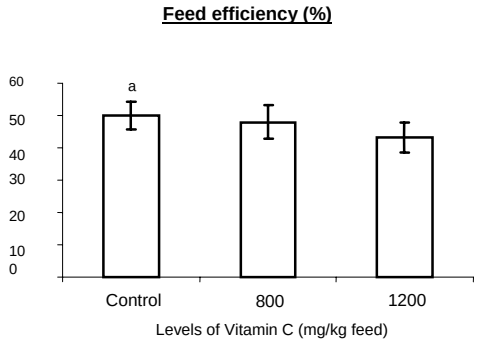

Fig 4: Feed efficiency ratio (FE) of pellet feed supplemented with and without Vitamin C fed by *H. fossilis* observed in a laboratory test. Bars (mean ±SEM) different letters indicate significant difference.

Mustafa *et al.* (1995) found 51.5 to 62.3% feed efficiency while working with red sea bream fed on feed having protein 38.5-39.3% and Aksnes *et al.*(1997) found 58 to 66% feed efficiency in his growth performance study of gilthead sea bream *Sparus aurata* [Linnaeus, 1758] with high quality fish meal which are not similar with our findings.

3.7 Average daily gain (ADG, g/d)

The values of Average daily gain (ADG) was highest in treatment 2 (0.27±.011 g/d) and lowest in control (0.13±0.003 g/d). The values of Average daily gain (ADG) of the experimental fish *H. fossilis* for treatment 1 (0.21±0.006 g/d) is higher than the control. In 1989, Sangrattanakhul (1989) found the value of ADG in *Anabas testudineus* is ranging from 0.100-0.120g which has similarities with our findings.

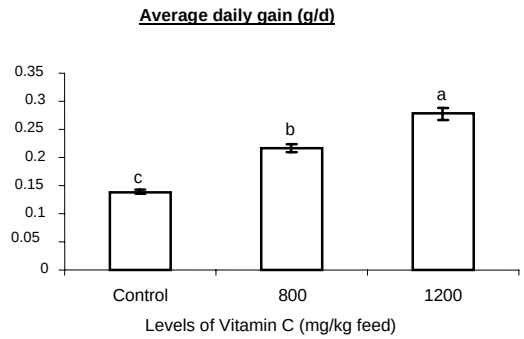

Fig 5: Average daily gain of pellet feed supplemented with and without Vitamin C fed by *H. fossilis* observed in a laboratory test. Bars (mean ±SEM) different letters indicate significant difference.

3.8 Specific growth rate (SGR, %/d)

The values of Specific growth rate (SGR%) of the experimental fish *H. fossilis* rearing in nine tanks fed on three different types of fish feed were estimated and the findings were different. The values of SGR% highest for treatment 2 (1.75±0.10 %) and lowest for control (0.81±0.016 %) but SGR% value of treatment 1 (1.46±0.096) is higher than control. "Organism age fastest when they are young" is expressed by Medawars (1945) fifth law. The SGR% value of shing fish in our experiment also shows the same trend mentioned in the law. Hossain and Parween (1998) was recorded the highest SGR (1.80) of *H. fossilis* by supplying diet which has more or less similarities with our finding values. This finding resembles the Medawars (1945) fifth law "the specific growth rate declines more and more slowly as the organism increases in age". Minot (1908) was the first person to recognize that for most animals the specific growth rate is highest early in life and that it typically decreases with increasing age, becoming zero in some animals.

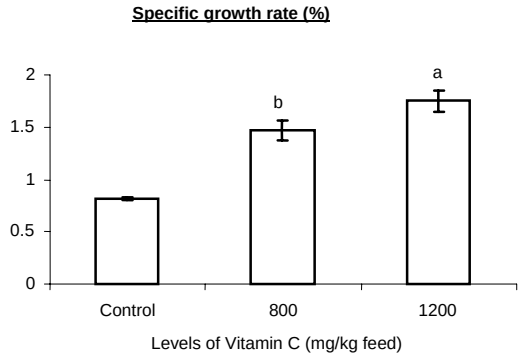

Fig 6: Specific growth rate of pellet feed supplemented with and without Vitamin C fed by *H. fossilis* observed in a laboratory experiment. Bars (mean ±SEM) different letters indicate significant difference.

3.9 Water quality parameters

During the whole experimental period water quality parameters were closely monitored and maintained. The values of water temperature ranged from 28.5-29.5^{0}C in all tanks. The variations of dissolved oxygen (DO) in all tanks during experimental period are ranged form 7.5-9.0mg/L. The values of pH and CO_2 ranged from 6.9-7.4 and 15-19 mg\L respectively in all tanks during the experimental period (Figure 7).

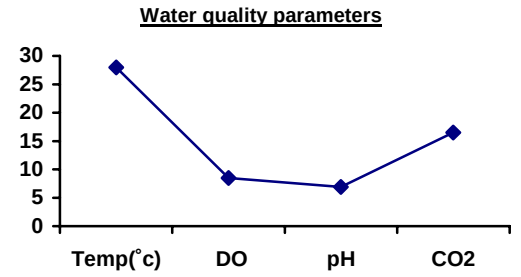

Fig 7: Approximate temperature, DO (mg/L), pH and CO2 (mg/L) determined from different tanks during 60 days trail of different Vitamin C level diet.

Chloride, hardness, alkalinity, nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N), ammonia-nitrogen (NH_3-N) were in suitable range for fish survival.

3.10 Statistical result

SGR, PER, FCR, ADG, Feed efficiency (FE) and Condition factor (K) data were transformed into square root transformations before analysis. Differences between treatments were compared by using one-way ANOVA with Tukey's HD post hoc for multiple comparisons. Statistical software SPSS version 12 was used to analyze data with the level of significance $p< 0.05$. According to the result we may concluded that formulated Diet C is the effective feed for the experimental fish *H. fossilis*.

Conclusion

The current study showed the dietary effect of Vitamin C of formulated fish feed on the feed utilization efficiency, body composition and growth performance of *H. fossilis* during rearing & feeding trail in the laboratory condition. During the study period FCR, PER and feed efficiency of the rearing *H. fossilis* showed results in favor of the use of prepared fish feed specifically diet with Vitamin C at 1200 mg/kg feed (Diet C). So, there is a significantly positive effect of the highest Vitamin C level (Diet C - 1200 mg/ kg of feed) on the growth, feed utilization & body composition which is demonstrated in this study. However, Vitamin C did not affect the survival rate. The effect of Vitamin C on reproductive performance is not highly significant. Successful aquaculture operations can be possible through supplementation of the Vitamin C level at 1200 mg/ kg of feed in the formulated feed which is more effective for the enhancement of growth & feed efficiency.

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