International Journal of Fisheries and Aquatic Research
www.fishjournals.com
ISSN: 2456-7248
Received: 19-03-2024, Accepted: 18-04-2024, Published: 03-05-2024
Volume 9, Issue 1, 2024, Page No. 33-38

Impact of formulated protein diets on growth performance of fish, *Cyprinus carpio* (*Linnaeus*, 1758)

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Abstract
Fresh water aquaculture in India is mainly carp-based and accounts for a considerable proportion of total aquaculture production. Feeding constitutes a major factor in fish culture since the fish obtain the maximum nutritional requirements through the food they consume. Protein forms one of the main components of fish feed and hence formulation of feeds that contain high amount of protein using cost effective natural ingredients is very essential to achieve efficient fish production. Feeding experiments were conducted to determine protein requirement of fingerlings of Cyprinus carpio using fish meal and groundnut oil cake as protein source. The effects of dietary protein levels [35%,40% and 45%] on growth parameters of Cyprinus carpio were studied up to 30 days. Growth parameters were increased gradually from 10 days to 30 days and from 35% to 45% protein fed diet containing different levels of crude protein (35%,40% and 45%).

Keywords: Protein, growth, fish meal, groundnut oil cake, *Cyprinus Carpio*

Introduction
The demand for fish has increased in recent years due to population growth and the constant search for a healthy diet. One of the major sources of animal protein for human consumption is fisheries resource. Therefore, considerable attention has been given to the production and growth of freshwater fish in aquaculture (Juin SK. *et al*.,2017)
A primary need for fish culture in large scale for commercial purpose is to obtain faster tissue growth on low budget. Aquaculturists try to improve the efficiency of food conversion by using different formulations in culture practice (Matty,1985)
Intensive aquaculture production is accompanied by stressful sitations cold, heat and crowd induced stress, which may affect not only physiological responses and homeostasis, but also profitability, production and sustainability of aquaculture industry worldwide (Hassan *et al.*,2021).
An adequate dietary protein level may reduce oxidative stress (Perez-jimenez *et al*.,2009; Castro *et al*.,2012) and improve stress resistance and immune response (Habte-Tsion *et al*.,2017; Zuo *et al*.,2017) Moreover, the adjustment of dietary protein and AA may provide precursors to sustain fish homeostasis and welfare [Costas *et al*.,2008; Wu,2013] [10]. Besides, under adverse conditions, voluntary feed intake may be impaired, and a protein/amino acid -fortified diet may be required to avoid deficiency signs.

Material and methods
- The fish, Cyprinus carpio are procured from state fisheries culture tanks and acclimatized to laboratory conditions for 10 days. Fish of uniform weight about 9 ±1gm were selected for each set of experiment.
- Protein supplemented diet fed for 10,20 & 30 days for experimental fishes.
- The commercially available fish meal was taken as control diet and fed for 10, 20, and 30 days for control fishes.
- The experimental diets were prepared with groundnut oil cake and fish meal, to make CP35% CP40% and CP45% protein diets.

Procurement and maintenance of fish
The fish, *Cyprinus carpio* were procured from State fisheries culture tanks. They were transported to the laboratory in oxygenated containers and treated with KMnO4 to avoid dermal infection and acclimatized to laboratory conditions for 10 days. The fish were fed with commercial feed once a day at a rate of 2% of body weight both before the experimental period. The temperature was maintained at 27 ± 1°C and water in the containers renewed every 24 hours. Fish of uniform size of 9±1 g were selected for each set of experiments. Fish were divided into four groups and kept in circular plastic troughs having a capacity of 20 liters. During experimental period, the fish were fed with control diet and experimental diets (Crude protein containing diet) for experimental groups.

Preparation of crude protein containing diets
The feed ingredients (commercially available Fish Meal) will be grinded and sieved to pass through 0.5 mm size sieve before incorporation of crude protein ground nut oil cake powder with experimental diets.
The control diet pellets were prepared by grinded fish meal powder.
Then, crude protein is mixed in 3 different groups of grinded fish meal at the level of 35%, 40% and 45% to prepare experimental diets by Pearson's square method.
Required amount of water was added to mix diet ingredients to form a dough and pellets were prepared using hand pelletizer, dried using air blower, sealed in vacuum packaged bags and stored until use to avoid bacterial or fungal contamination.

Diet [1]: Control diet [The commercially available fish meal]

Diet [2]: 35% of crude protein diet [prepared by square method]

- To make 100 grams of 35% CP diet, take 34.63g of ground nut oil cake powder and 65.37g fish meal powder.

Diet [3]: 40%of crude protein diet [prepared by squared method]

- To make 100 grams of 40% CP diet, take 69.25g of ground nut oil cake powder and 30.75g fish meal powder.

Diet [4]: 45% of crude protein [prepared by squared method]

- To make 100 grams of 45% CP diet, take 96.40g of ground nut oil cake powder and 3.60g fish meal powder.

Impact of crude protein on Weight gain (WG), Specific growth rate (SGR), Hepatosomatic index (HSI), levels in fish, *CYPRINUS CARPIO* were studied in three experimental fish groups (CP 35%, CP 40% and CP 45%) along with control group. Fresh water aquaculture in India is mainly carp-based and accounts for a considerable proportion of total aquaculture production. Feeding constitutes a major factor in fish culture since the fish obtain the maximum nutritional requirements through the food they consume. Protein forms one of the main components of fish feed and hence formulation of feeds that contain high amount of protein using cost effective natural ingredients is very essential to achieve efficient fish production. Feeding experiments were conducted to determine protein requirement of fingerlings of Cyprinus carpio using fish meal and groundnut oil cake as protein source. The effects of dietary protein levels [35%,40% and 45%] on growth parameters of Cyprinus carpio were studied up to 30 days.

Growth parameters

Growth performance and feed conversion efficiency were calculated as follows.

1. Weight gain/ loss was estimated by Ricker method (1975)
   Weight gain/ loss = W2 - W1.
   Where, W1 and W2 are the Initial and final weight of fish in grams.
2. Specific Growth Rate (SGR) was estimated by Ricker method (1975)
   SGR = 100(log W2 –log W1) / T
   T is the no. of days of the feeding period.
3. Hepatosomatic Index (HSI) was estimated by Parameswaran *et al.* method (1974)
   HSI = Weight of Liver / Weight of fish x 1

Statistical analysis

All data were presented as Mean ± SE. For each experimental treatment, three replicates of 10 individuals were taken. For each replicate, under each Treatment Mean was calculated. The three Mean values thus obtained were used to calculate experimental treatment Mean and Standard Errors of Mean. The student's 't'-test was applied between control values and each of the experimental treatment values. p values were determined using the t-statistics and degrees of freedom (df) and denoted as NS- Not Significant; * - $p < 0.05$; ** - $p < 0.01$; *** - $p < 0.001$. The results were statistically analyzed using Duncan's multiple range tests to determine difference in means Software Program of Statistical Analysis (SPSS, 2008).

Results and discussion

Effect of different feed concentrations (35%, 40%,45%cp) of crude protein up to 30 days (10,20 and 30 days) of exposure on growth parameters of fish, Cyprinus carpio were studied. The results of growth parameters were given in table (1 to 3) in terms of Mean with Standard Error values over control.

In the present investigation, the difference in Weightgain was significantly increased compared to control. Weight gain was increased more at high percentage of protein (45%) and longer duration (30days). After 30 days of Crude protein exposure, the difference in weight gain was increased under 45% cp (13.27g – 9.15g = 9.16g, $p < 0.001$) followed by 40% (12.81g – 9.2g = 3.61g, $p < 0.001$) and 35% (12.37g – 9.2g = 3.25g, $p < 0.001$), compared to control (11.88g – 9.16g = 2.72g). The increase in fish body weight by Crude protein may be due to the induced feed digestion and absorbtion rate. Similar results were observed in the Gold fish, Carassius auratus given feed supplemented with different protein diets(plant and animal protein) experienced increased body weightgain and specific The present study indicates that increase of dietary protein levels from 35 to 45%had significantly affect the growth of fish. Therefore inclusion of 35 to 45% dietary protein in the diet was useful for maximum growth. The similar result were showed a significantly enhancement in the growth performance of Triploid crucian carp after fed the different dietary protein source [Liquan yang *et al* 2024] [2] 1 growth rate SGR levels significantly compared to control (Bilen S. 2013)1.

the present research study, Specific growth rate (SGR) of fish was significantly increased compared to control. Specific growth rate (SGR) of fish was increased under the higher percentage of crude protein (45%) and longer duration. At the end of the 30 days of crude protein exposure, Specific growth rate (SGR) was increased under 45% (0.53, $p < 0.001$) followed by 40% (0.48, $p < 0.01$) and 35% (0.44, $p < 0.05$), compared to control (0.37) The increase in Specific growth rate (SGR) by crude protein containing diet may be due to the increased body weight of fish. According to Iszhtiyaz ahmed and Impiaz ahmed [2020] 3, who have reported that, there was relatively greater enhancement of SGR in fingerlings of rainbowtrout. Therefore inclusion of 35 to 45% dietary protein in the diet for useful for maximum growth. The similar result were showed a significantly enhancement in the growth performance of Triploid crucian carp after fed the different dietary protein source [Liquan yang *et al* 2024] [2] 4 Hepatosomatic Index (HSI) of fish was significantly increased compared to control. Hepatosomatic Index of fish was increased more under the higher levels of crude protein (45%) and longer duration (30 days). After 30 days of Crude protein exposure, Hepatosomatic Index was increased under 45% (1.80, $p < 0.001$) followed by 40% (1.71, $p < 0.01$) and 35% (1.61, $p < 0.05$), compared to control (1.51). The increased level of HSI index by fed the diet containing different protein percentage (CP 35%, CP40%, CP45%) increased value of HSI or due to the low glycogen deposition or fat accumulation in the liver affect proper liver function. The similar result were obtained higher HSI in the fingerlings of rainbowtrout. (Yang *et al* 2016 Wang *et al* 2016 Wu *et al* 2015 Jiang *et al* 2015)

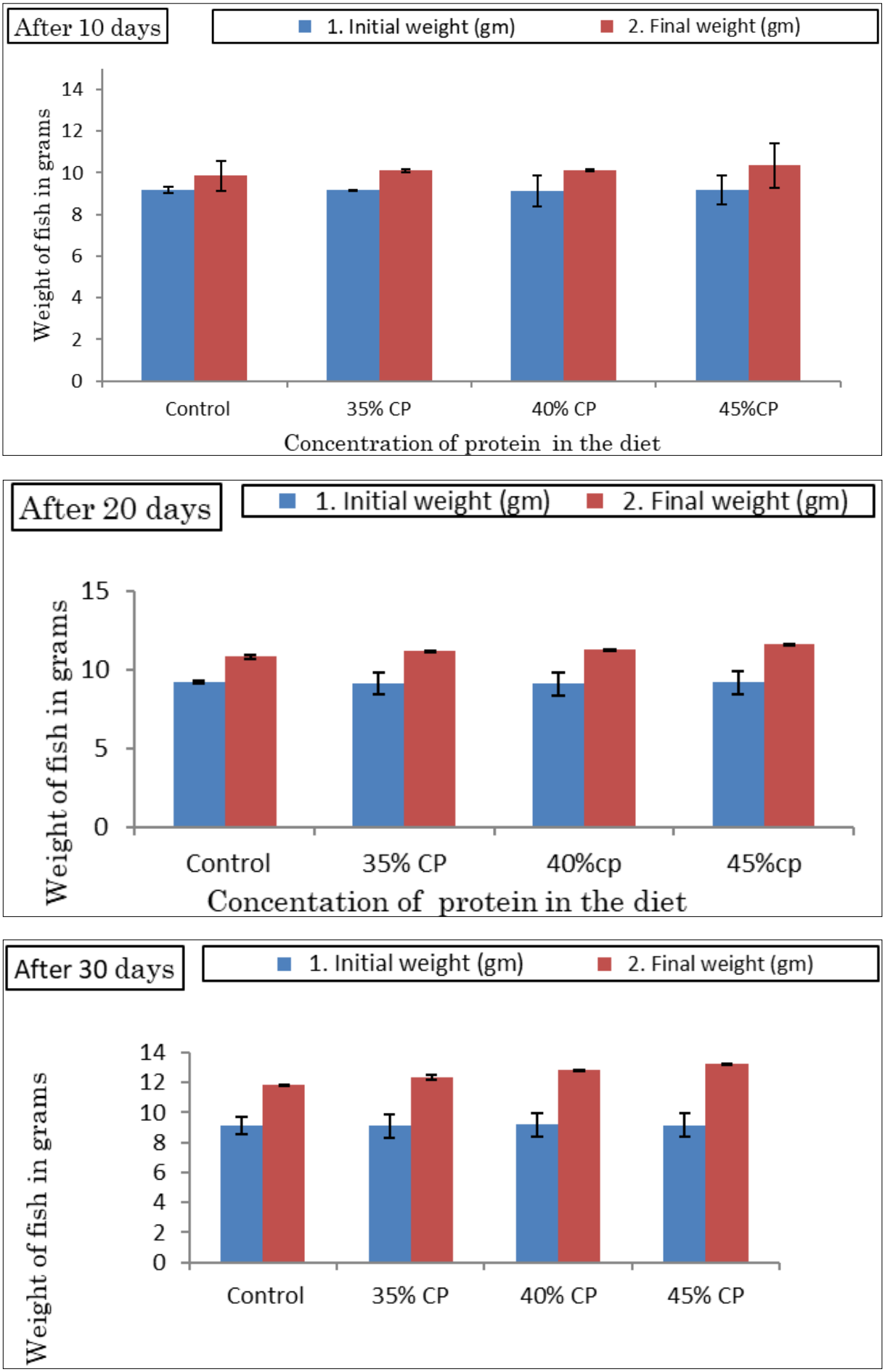

Fig 1: Growth performance parameters of Cyprinus Carpio fed diet containg different levels of crude protein used as a growth promoter

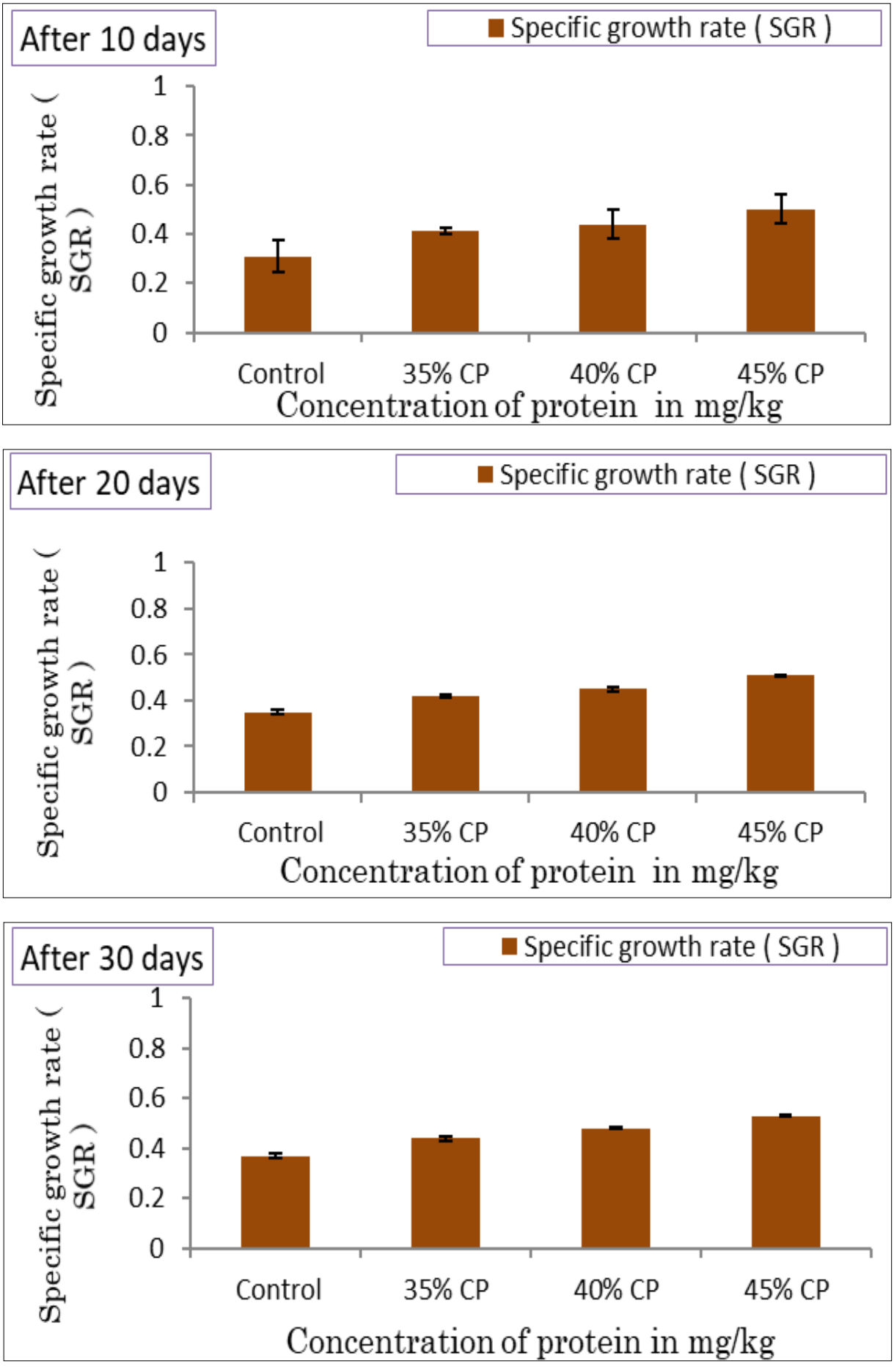

Fig 2: Secific growth rate parameters of cyprinus carpio fed diet containg different levels of crude protein (mg/kg feed) used as a growth promoter

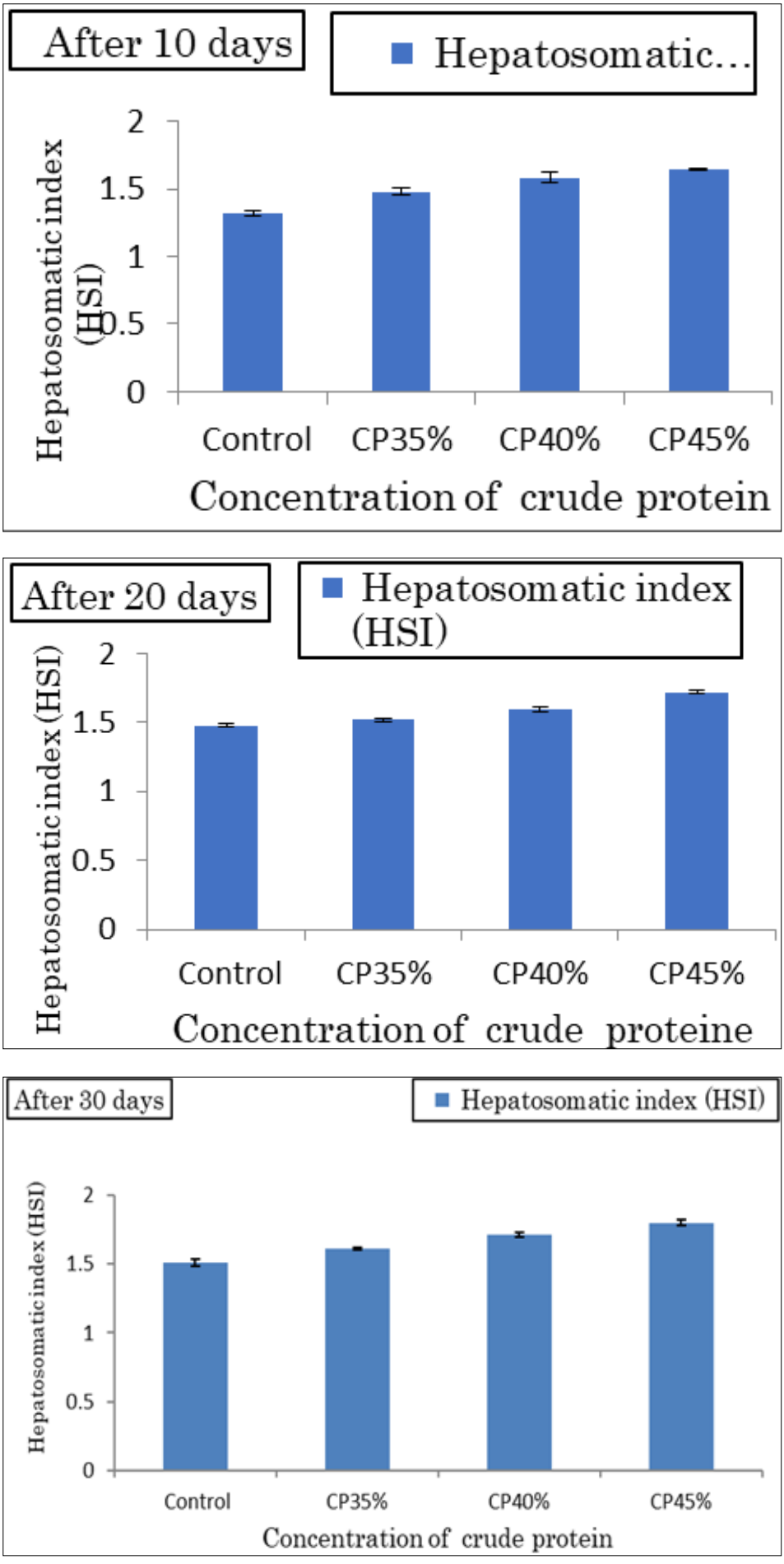

Fig 3: Changes in Hepatosomatic index (HSI), of Cyprinus carpio fed diet containing different percentage of protein diet used as growth promter

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