



## Utilization of Water Hyacinth (*Eichhornia crasipes*) Meal as Partial Replacement for Fish meal on the Growth Performance of *Cyprinus carpio* fry

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### Abstract

*Cyprinus carpio* (L.) fry were fed with a control (0% water hyacinth) and three different experimental diets, containing 15%, 30% and 45% of water hyacinth in place of fish meal as protein source at 5% of the body weight for 120 days under laboratory condition. The study revealed a decrease in the growth performance indices as the percentage of water hyacinth increases. The results also clearly showed that fry fed with diet 15% water hyacinth dietary inclusion perform the best result among three different experimental diets. Although fishmeal is non replaceable but can be supplemented with water hyacinth up to an optimum level to produce cost effective feed for the growth performance of *Cyprinus carpio*. There was no significant difference between the growth performance of fish that were fed diets containing up to 15% water hyacinth and fish that were fed the control diet ( $P < 0.05$ ), except for the group of fish on the 45% water hyacinth diet. Also, no significant difference was observed among treatments with respect to feed utilization ( $P < 0.05$ ).

**Keywords:** Water hyacinth, feed ingredients, fish meal, growth performance, *Cyprinus carpio*.

### Introduction

The whole nutritional requirements of fish depend mainly on the availability of suitable diets which provide required nutrients for optimum growth. The carrying capacity of culture system is known to be increased by supplementary feeding and enhanced fish production by many folds<sup>1</sup>. The nutritive value of water hyacinth and its usefulness as animal feed have reported by many workers<sup>2-3</sup>. To reduce the dependence on animal based protein in fish diet, plant based protein feedstuffs are used which also decreases feed cost of artificial fish meal<sup>4</sup>. Locally available selected macrophytes have been experimented as alternative food sources, which can be used for preparation of feed<sup>5</sup>. One important aspect in common carp farming is to formulate economically viable and easily available ingredients. Under controlled conditions of carp culture Feed Conversion Ratio (FCR) values of various fish feeding ingredients have been estimated by many workers<sup>6-9</sup>.

Common carp is an omnivorous fish and can eat artificial protein rich food stuffs such as silkworm pupae, dried insects, fish meal, blood meal, carcass meal, flesh of molluscs minced flesh of fish, frog and snake<sup>10</sup>. Inconsistent supply and soaring prices of conventional pelleted fish feed has relentlessly compelled the development of low-cost aquaculture system suitable for farmers in the developing countries<sup>11-12</sup>. In this contest, fish nutritionist have stepped up their endeavors aimed at screening of alternate materials of plant origin including aquatic and terrestrial macrophytes to prepare cost effective and

nutritionally balanced diet for fish and poultry<sup>13-16</sup>. The present trial was undertaken to quantitatively analyze the comparative efficacy of different formulated feeds of plant and animal origin in relation to growth of fry of *Cyprinus carpio*. The feeds selected for this investigation are fish meal of animal origin and water hyacinth (*Eichhornia*) of plant origin. This experiment is conducted to determine the use of *Eichhornia* meal as partial replacement of fish meal in diet of common carp fry, in order to reduce the cost of feed and evaluate the growth performance of fry.

### Material and Methods

**Experimental fish:** *Cyprinus carpio* (L.) (Common carp) was selected for the present experiment. The rationale of its selection was that it has excellent growth rate, easy availability wide distribution, commercial importance etc. It is tolerant and hardy fish for better survival in a wide variety of aquatic habitats. Its seed has been high demand by the aqua-farmers for variety of purposes such as monoculture and polyculture. In view of consistent demand for fry and fingerlings, studies were therefore undertaken in aquaria and ponds.

Fry of *Cyprinus carpio* were obtained from Government fish farm and acclimatized for 15 days in laboratory condition on the feed supplement containing rice bran and Groundnut oil cake (GNOC) in order to habituate them for artificial feeding. Thereafter, during experimental period of 120 days, the fishes were fed with formulated artificial diets @5% body weight/day.

The weight of fry were measured after every 15 days and based on the increase in body weight of fry and their ration was readjusted @ 5% of their body weight twice daily.

**Experimental diets:** The present experiment was undertaken to utilize the aquatic weeds and trash fish to prepare the experimental diet. The ingredients, i.e. rice bran, GNOC, soybean, fish meal and *Eichhornia* were procured from local area and were dried and grinded to powder form. Four diets were formulated in which fish meal was replaced with *Eichhornia* meal at 0%, 15%, 30%, and 45% levels. The diets were fortified with vitamins and salt.

**Experimental procedure:** Twelve glass aquaria in triplicate for each dietary treatment were selected for the experiment. The working dimension of each aquarium was 60x40x45 cm<sup>3</sup>. A total of 450 nos. of *Cyprinus carpio* fry of average 1.61± 0.21g body weight were distributed in to 30 groups of 15 fish each group. The study was conducted for 120 days. The water quality parameters, temperature, pH, DO were analyzed through the methods outlined APHA and monitored daily<sup>17</sup>. Water quality samples were collected fortnightly from each aquarium and their average values were calculated on monthly basis.

**Statistical analysis:** The data collected were subjected to analysis of variance (ANOVA) using Microsoft software Statistica followed by uncan's multiple range tests to compare the result<sup>18</sup>.

## Results and Discussion

In the present study, the chief ingredients of experimental diets at different proportions include *Eichhornia*, Fishmeal, Soybean,

Groundnut oil cake, Rice bran, Vitamin, and Salt are shown in table-1. The proximate analysis of *Eichhornia* based experimental diets are recorded in table-2. The growth Performance characteristic of the fry fed *Eichhornia* is shown in table-3. The fish meal was replaced by 0%, 15%, 30%, and 45% *Eichhornia*. The percentage of crude protein, crude lipid, ash, moisture and crude fibers in the formulated fish diet were ranged from 33.12-40.12%, 5.2-8.5%, 11.03-13%, 2.2-3.9% and 4.9-8.3% respectively. The highest percentage of crude protein (40.12%) was recorded at 0% replacement of *Eichhornia* feed and the least (35.82%) was at 45% replacement.

Feeds from plant origin have an excellent amino acid profile and reported to be effective and less expensive ingredients for formulation of artificial fish diets<sup>19</sup>. For the past several years, one of the main directions in improving fish feeds has been the search for protein source alternatives to fish meal and determining their nutritional suitability in diets. In the past few decades, feeds from plant origin have been accepted for Indian major carps because the growth observed in these fish has been reported to be as good as that obtained with the traditional feed. In tropical developing countries, where algal production rates are high, algae have been receiving increasing attention as an alternate protein possessing relatively high protein content (50–65%), which may be included in balanced fish feeds<sup>20</sup>. The current study demonstrated that the three inclusion level of water hyacinth experimental feed supported the growth for *Cyprinus carpio* (L.) fry. Thus, incorporation level up to 45% *Eichhornia* meal to replace the fish meal in formulated diet did not exert any adverse effect on growth Performance of *Cyprinus carpio* (L.) fry.

**Table- 1**  
Percentage composition of *Eichhornia* meal based experimental feed

Ingredients	Percentage inclusion of <i>Eichhornia</i>			
	0%	15%	30%	45%
<i>Eichhornia</i>	0	3.9	7.8	11.7
Fish meal	26.5	22.6	18.7	14.8
Soybean	20.0	20.0	20.0	20.0
GNOC	30.0	30.0	30.0	30.0
Rice bran	22.0	22.0	22.0	22.0
Vitamin	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Total	100.0	100.0	100.0	100.0

**Table-2**  
Proximate Composition of Experimental feeds

<i>Eichhornia</i> feed	Crude protein (%)	Crude lipid (%)	Ash (%)	Moisture (%)	Crude fibre(%)
0%	40.12	8.5	13.0	2.2	4.9
15%	34.44	5.8	12.8	3.2	7.2
30%	33.67	5.3	12.1	3.4	7.8
45%	33.12	5.2	11.03	3.9	8.3

Growth performance of common carp fry fed with *Eichhornia* meal based feed for 120 days shows that there was a decreasing trend with increasing level of *Eichhornia* feed from 15% to 45% replacement. It has also been observed that the growth performance of common carp in 15% replacement was less than the 0% replacement of *Eichhornia* feed so far as the protein content in respective replacement was concerned. It proves that, although animal protein is essential for the growth of carp, plant protein has no less importance for the same cause. It is apparent from the results of the present study that fry fed with 0% inclusion of *Eichhornia* meal showed better growth performance which was not significantly different ( $P < 0.05$ ) from the 15% inclusion of the *Eichhornia* diet. The *Eichhornia* feed at 45% replacement exhibited significant impact on the growth performance of the common carp fry.

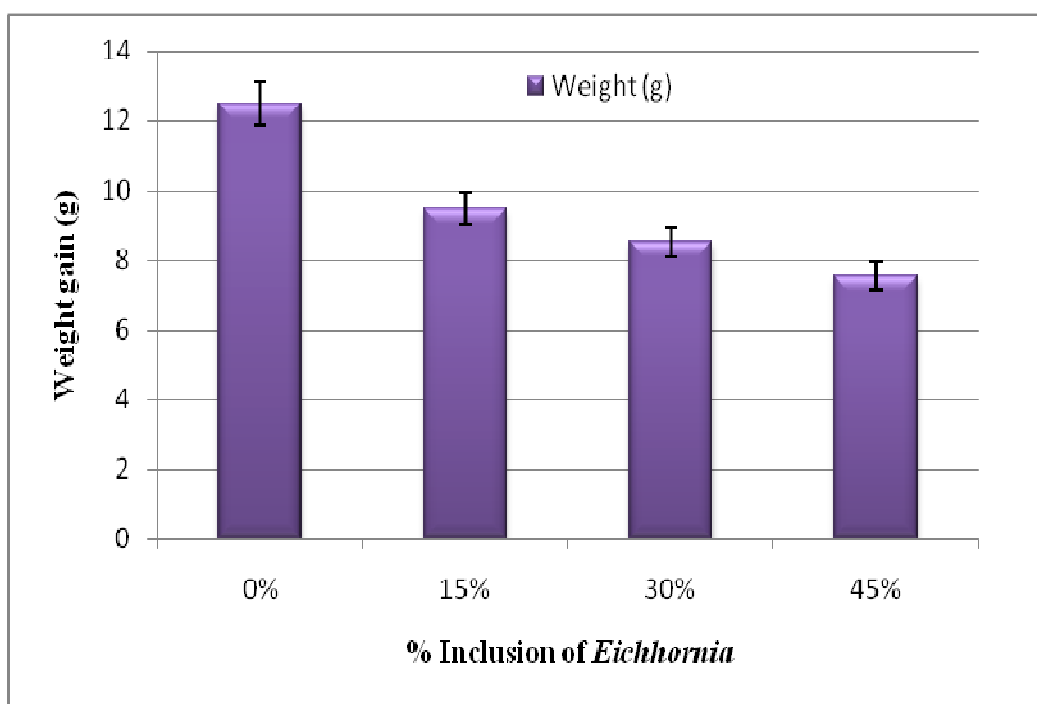
It has been reported that inclusion of water hyacinth significantly increases the crude fiber content of the feeds<sup>21</sup>.

This probably affects the food conversion ratio and the feed utilization by the fry. High fiber in feed plays a significant role in digestion of feed. Another study has observed that the lipid component reduces as the water hyacinth inclusion levels increases followed by optimum growth in fish<sup>22</sup>. The crude protein of the experimental diets were close to what was reported as optimum for the culture of catfish<sup>23</sup>. Replacement of water hyacinth meal for 15% fish meal promotes higher ( $p < 0.05$ ) final weight than feeding fish meal up to 45% replacement.

Survival was generally high in all the fingerlings fed with the water hyacinth supplemented diets. The cost of production and the benefits positively favored all treatments since the values computed are  $> 1.0$  which shows an increase in the fish value above the amount invested. This notwithstanding, more monetary profit awaits a farmer when 15% of water hyacinth meal is used to replacement fish meal in the diets of *C. carpio*.

**Table-3**  
**Growth performance of common carp fry fed *Eichhornia* meal based diet for 120 days ( $\pm$ SE)**

Parameters	0%	15%	30%	45%
Initial wt (g)	1.72 $\pm$ 0.21	1.64 $\pm$ 0.20	1.61 $\pm$ 0.19	1.62 $\pm$ 0.19
Final Wt (g)	14.22 $\pm$ 0.72	11.12 $\pm$ 0.52	10.14 $\pm$ 0.48	9.16 $\pm$ 0.45
Total wt gain (g)	12.50 $\pm$ 0.62	9.48 $\pm$ 0.47	8.53 $\pm$ 0.42	7.54 $\pm$ 0.41
Body wt gain %	726.74 $\pm$ 3.86	578.04 $\pm$ 2.74	529.81 $\pm$ 2.58	465.143 $\pm$ 2.37
Growth rate, g/day	0.104 $\pm$ 0.02	0.079 $\pm$ 0.03	0.071 $\pm$ 0.03	0.062 $\pm$ 0.04
% of survival	87	67	67	60



**Figure-1**  
 Total weight gain (g) of carp fry fed with % inclusion of *Eichhornia* meal based feed ( $\pm$ ).

In recent years increasing attention has been given on formulation of cost effective protein rich artificial feed for intensive fish culture<sup>24</sup>. Increase in dietary protein has often been associated with higher growth rate in many fish species as fish require high protein content diet for better growth<sup>25</sup>. The results of various experiments indicate that the most important significant factor that influences growth, survival and yield of fish is the quantity and quality of dietary protein of fish feed<sup>26</sup>. Therefore, considerable research effort is needed to determine the quantity and quality of dietary protein necessary to achieve optimum growth performance of fish. To formulate low cost feed, ingredients from plant and animal sources are used to fulfill the protein requirement of the fish meal, fully or partially. The inter-relationship between the dietary energy requirement and the growth of fish and the importance of proper protein nutrition has been well established. So, fish nutritionists pay greater attention to reduce the cost of artificial diets by introducing alternative protein sources from plant and animal<sup>27</sup>. This result is similar to the report of several authors who have demonstrated the use of several species of *Eichhornia* as partial replacement for fishmeal in the diet of fish and other animals. The study clearly showed that fish fed diet with 15% inclusion of *Eichhornia* perform excellently well compared to other treatment.

## Conclusion

Recently wide varieties of non conventional protein of both plant and animal origin have been evaluated and used to formulate fish diet. Therefore, efforts are now being directed in different part of the globe to find alternate protein sources of good quality without affecting adverse effect on growth performance of fish. Studies have been carried out on the development of new feed formulation for carps in fresh water aquaculture system. The experiment concludes that fish meal could not be replaced totally with plant; however, partial replacement can be done by using *Eichhornia* meal to reduce the cost without affecting growth rate. The present study revealed that 15% *Eichhornia* feed would be optimum for the maximum growth of *Cyprinus carpio* (L.). Further, such aquatic weed based feeds are cheaper as compared to the conventional feeds, supplementation of aquatic weeds in carp diets would also prove economically viable.

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