

## Effect of Partial Replacement of Fishmeal with Duck Weed (*Lemna minor*) Feed On the Growth Performance of *Cyprinus carpio* Fry

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**Abstract:** The acceptable nutritional value of *Lemna* as an ingredient in diets for *Cyprinus carpio* (L.) fry was experimented under aquarium culture system for 120 days. For that purpose fry of approximately equal weight were distributed in groups of 15 to each four aquaria at 0%, 15%, 30% and 45% inclusion levels of *Lemna*. The fry were fed at 5% body weight twice daily morning and evening. The three inclusion levels of duckweed supported the growth of *Cyprinus carpio* fry but growth performance, weight gain growth rate was favoured by low inclusion of duckweed meal. Highest bodyweight gain % was recorded on the group of fish fed diet (0% inclusion of duckweed) which was not significantly different ( $P < 0.05$ ) from (15% level inclusion of duckweed). The study clearly showed that fry fed diet 15% duckweed dietary inclusion perform best result and fishmeal was non replaceable but can be supplemented with duckweed up to an optimum level to produce cost effective feed.

**Key words:** Duck weed, Feed ingredients, growth performance

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### I. Introduction

The success of commercial aquaculture operations depends mainly on one key biological component that is the availability of suitable diets which provide required nutrients for optimum growth. As a result, use of supplementary feed has become inevitable for the carrying capacity of culture systems and can enhance fish production by many folds [1]. One important aspect in common carp farming is to identify economically viable and easily available ingredients for formulating diets that are nutritive palatable and having maximal conversion ratio to give greater fish yield per application. Feed conversion ratio (FCR) values of various fish feeding ingredients for carps under controlled conditions have been estimated by many workers [2,3,4,5].

The artificial feed for the growth of common carp depends upon the local environment, culture method, stocking density, quality and quantity of feed supplied. Common carp is an omnivorous fish and can eat any digestible feed item. It eats artificial protein rich food stuffs such as fish meal, blood meal, carcass meal, dried insects, silkworm pupae, flesh of molluscs minced flesh of fish, frog and snake [6]. In fact significant effort has been directed towards evaluating the nutritive value of different non-conventional feed resources including terrestrial and aquatic macrophytes to formulate nutritionally balanced and cost effective diet for fish and poultry [7,8,9,10].

Studies on growth performance of cultured fry of common carp in relation to feeding provide information for successful application in the management and exploitation of resources. 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 duckweed (*Lemna minor*) meal of plant origin. Duckweed meal has been known for its high nutritive value with as much as 40% and above crude protein depending on the culture system [11,12,13,14,15].

The present study was conducted to assess the suitability or otherwise of duckweed meal as a partial replacement for the artificial meal in the diet of *Cyprinus carpio* fry.

### II. Materials And Methods

#### Experimental fish

The common carp, *Cyprinus carpio* (L.) (1758) has been one of the oldest cultured species of fish for food. It 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 a hardy fish for better survival. Its seed has been high demand by the aqua-farmers for variety of purposes such as mono-culture and poly culture. In view of consistent demand for fry and fingerlings, studies were therefore undertaken in aquaria and ponds.

Fry of *Cyprinus carpio* were collected from Government fish feed hatchery. The fry were kept in the glass aquaria and acclimatized for 15 days 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 the formulated experimental diets @5% of 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**

In this present study, an attempt was made to utilize the aquatic weeds and trash fish for feed preparation. The ingredients, i.e. rice bran, GNOC, soybean, fish meal and *Lemna* were procured from local area and were dried and grinded to powder form. Four dry diets were prepared in which fish meal was replaced with weeds at 0%, 15%, 30%, and 45% levels. The diets were fortified with vitamins and salt.

**Experimental procedure**

The experiment was run in 12 glass aquaria in triplicate for each dietary treatment. 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 by APHA (1985) [16] and monitored daily. Water samples from all the aquaria also taken on fortnightly basis to see the changes in physicochemical factors and their average values were calculated on monthly basis.

**Statistical analysis:**

Statistical analysis of data was performed by analysis of variance (ANOVA) using Microsoft Software statistic followed by Duncan’s multiple range test [17].

**Table: 1 Percentage composition of experimental feed of *Lemna***

Ingredients	Percentage inclusion of <i>Lemna</i>			
	0%	15%	30%	45%
<i>Lemna</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
Groundnut oil cake (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 feed of *Lemna***

<i>Lemna</i> feed	% crude protein	% crude lipid	% Ash	% Moisture	% crude fiber
0%	40.12	8.5	13.0	2.2	4.9
15%	38.60	6.8	12.2	1.4	4.5
30%	36.54	6.4	11.0	1.3	4.8
45%	35.82	6.0	10.3	1.6	5.2

**III. Results And Discussion**

Feeds from plant origin have an excellent amino acid profile been reported to be effective and less expensive ingredients for formulation of fish diets [18]. 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 [19].

Incorporation of *Lemna* feed (commonly known as duckweed meal) to replace the fish meal in formulated fish feed can be attributed to achieve the goal of formation of cost-effective fish feed. The three inclusion level of duckweed is experimental feed supported the growth for *Cyprinus carpio* (L.). However, growth performance was favoured by optimum inclusion level of duckweed meal in the experimental feed. In the present study, the experimental diets of *Lemna* meals are represented in Table-1. The ingredients of experimental diet include *Lemna*, Fishmeal, Soybean, Groundnut oil cake, Rice bran, Vitamin, and Salt at different proportions of *Lemna* meal. The proximate composition of the *Lemna* feeds are recorded in Table-2.

The fish meal was replaced by 0%,15%, 30%, and 45% *Lemna* feed. The highest percentage of crude protein(40.12%) was recorded at 0% replacement of *Lemna* feed and the least (35.82%) was at 45% replacement.

Data on growth performance, weight gain, growth rate and survival rate are presented in Table-3. A decreasing trend in growth performance was noticed with increasing level of *Lemna* feed from 15% to 45% replacement. It has also been observed that the growth performance of common carp in 0% replacement was

more than the 15% replacement of *Lemna* feed so far as the protein content in respective replacement was concerned. No doubt, animal protein is essential for the growth of carp, plant protein has no less importance for the same cause. Probably, due to that reason, the *Lemna* feed at 15% replacement has shown significantly higher ( $P<0.05$ ) impact than the other three treatments on the growth performance of the common carp (Figure 1).

Highest body weight gain % was recorded on the group of fish fed diet (0% level of inclusion of *Lemna*) which was not significantly different ( $P<0.05$ ) from the (15% level of inclusion of *Lemna*) (Figure 2). The percentage of survival rate was highest in 0% and lowest in 30% *Lemna* replacement fish meal.

The intensification of fish culture has led to dependence on artificial feeds. Protein is the most expensive component in fish feeds and also the most important factor affecting growth performance of fish and feed cost [20]. Reducing the feeding costs could be a key factor for the successful development of aquaculture. Fish have high dietary protein requirement [21]. The significance of qualitative and quantitative feeds is well recognized [22] and the level of dietary protein is of fundamental importance, because it significantly influences growth, survival and yield of fish. 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 a 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

**Table 3: Growth performance of common carp fry fed *Lemna* meal based feed for 120 days ( $\pm$ SE)**

Parameters	0%	15%	30%	45%
Initial weight (g)	1.72 $\pm$ 0.21	1.62 $\pm$ 0.19	1.60 $\pm$ 0.18	1.51 $\pm$ 0.17
Final wt (g)	14.22 $\pm$ 0.72	13.47 $\pm$ 0.68	12.84 $\pm$ 0.63	11.23 $\pm$ 0.54
Total wt gain (g)	12.50 $\pm$ 0.62	11.85 $\pm$ 0.57	11.24 $\pm$ 0.53	9.72 $\pm$ 0.49
Body wt gain %	726.74 $\pm$ 3.86	731.48 $\pm$ 3.88	702.50 $\pm$ 3.53	643.70 $\pm$ 2.91
Growth rate(g/day)	0.104 $\pm$ 0.02	0.098 $\pm$ 0.02	0.093 $\pm$ 0.02	0.081 $\pm$ 0.03
% of survival	87	80	67	73

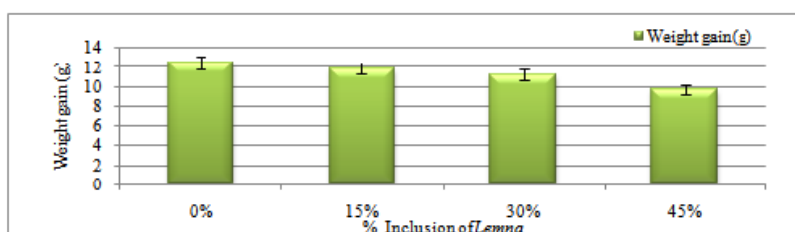


Figure 1 Total weight gain(g) of carp fry fed with % inclusion of *Lemna* meal based feed ( $\pm$ SE).

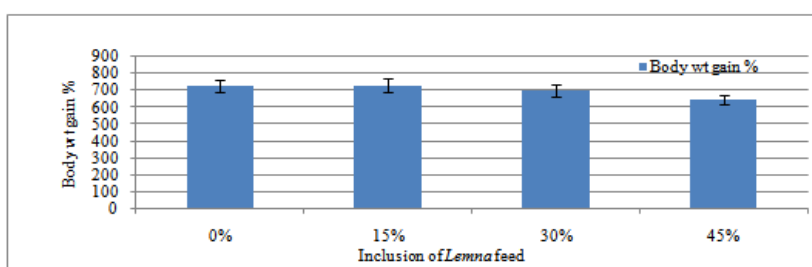


Figure 2 Body weight gain % ( $\pm$ SE) of *Cyprinus carpio* fry fed with *Lemna* meal based feed at different proportion.

from plant and animal [23]. This result is similar to the report of several authors who have demonstrated the use of several species of duckweed as partial replacement for fishmeal in the diet of fish and other animals. Faskin et al. (2001) reported the use of duckweed *Spirodella polyrrhiza* in the diet of the Nile Tilapia (*Oreochromis niloticus*) [24]. Yilmaz et al. (2005) also observed no weight difference when 20% duckweed meal substituted for commercial fish meal in common carp (*Cyprinus carpio*). The growth depression that was observed at 30% fermented *Lemna* leaf meal incorporated in the diet of *Labeo rohita* gave the best performance in term of efficiency. The complete replacement of fish meal with duckweed is detrimental to fish production [25]. This is supported by the earlier workers [22, 23, 24] and Tavares et al. (2008) who have reported that 100% inclusion of duckweed does not favour growth performance of Nile Tilapia [26]. The study clearly showed that fish fed diet with 15% duckweed perform excellently well compared to other treatment.

#### IV. Conclusion

Fish nutritionists have tried since years to replace the expensive fish meal component of fish feeds with less expensive plant protein feed stuffs. For maximum growth of fish, optimum protein content in the feed is necessary. Generally, protein is recognized as a frequent limiting factor for growth of cultured fish. Studies pertaining to nutrition in freshwater aquaculture had resulted in the development of new feed formulations for carps. The experiment concludes that fish meal could not be replaced totally with plant origin feed; however, partial replacement can be done by using duckweed meal to reduce the cost without affecting growth rate. The present study revealed that 15% *Lemna* 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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