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ON THE DIET SUBSTITUTION AND ADAPTATION WEIGHT IN CARP *Cyprinus carpio* LARVAE

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ABSTRACT

Feeding trials were conducted on carp *Cyprinus carpio* larvae from commencement of exogenous feeding through different ages to study the impact of diet substitution on their growth and survival. Larvae given artificial diet from the day first of exogenous feeding failed to survive beyond the age of 15 days. When tested for a combination of cultured live prey organisms and dry diet in different proportions, most satisfactory results in terms of growth and survival were met with a 1:1 diet formulation. However, best results of percent survival and growth increment were obtained when the larvae were fed live cultured cladoceran, *Ceriodaphia reticulate,* from commencement of exogenous feeding. Later the *Ceriodaphia* fed larvae and post-larvae, weaned on to traditional fish diet of 1:1 rice-bran and mustard oil-cake, revealed that post-larvae of 15 mg wt. and a length of 12mm or above exhibited an improved ability to utilize and survive on the traditional artificial dry diet.

KEY WORDS: *Cyprinus carpio,* first exogenous feeding, weaning weight, mortality

Common carp *Cyprinus carpio* does not inhabit the natural water bodies of Jammu of J&K State except Mansar Lake, where fishing is prohibited for religious reasons. The fish farmers, having started intensive carp culturing, rely mostly on the State Fisheries Department for the supply of seed. No critical field studies are available on the utilization or acceptance of traditional feeds 'rice-bran and oil cake,1:1 routinely added into the carp nursery farms soon after seeding. Laboratory studies have revealed that larvae of many fish species, including the carp, appear to feed preferentially on zooplankton but show poor growth and survival when reared entirely on dry feeds during early days of life, which makes feeding of fish larvae on zooplankton indispensable at least during these first few days of their life (Kuzminishki et al., 1996). The lack or acute shortage of right type & size of live food for larvae, initiating feeding in carp nursery ponds in India, has been suspected as one of the causes of larval mortality (Jhingran, 1991).Therefore , for any success in a semi-intensive carp culture, it becomes important to know (i) the right proportion in which zooplankton and dry diet should be combined, so as to rely upon for acceptable growth and better survival of larvae; and (ii) the minimum body weight / size at which so fed carp larvae could be successfully weaned on to exclusively dry food.

Growth and survival are powerful tools for understanding the effects of both live and artificial diets on fish larvae at first-feeding (Wang et al., 2005). The paper presents the data in respect of these two considerations for understanding the suitability of live and artificial diets and the most appropriate weaning weight of fish larvae.

MATERIALS AND METHODS

Two experiments were conducted in this regard.

Experiment 1: Relative Diet Substitution

Three day old larvae, about to commence exogenous feeding, were used for this experiment and five feeding regimes were tested over a period of 26 days. The diet formulation tested included live feed and dry diet in different proportions (Table -1).

Live feed comprised the cladocerans, *Ceriodaphnia reticulata*, cultured on fermented rice-bran (0.2g/l) and sheep's liver (0.05 g/l) in a 100 liter concrete pond. The live food was given at different ages as recommended by Bryant and Matty (1980). The dry feed consisted of traditional rice-bran and oil-cake (1:1) and provided to the larvae at the rate of 50% of their body weight (Szlaminska and Przybyl, 1986) and to postlarvae and fry at 16% and 10% of body weight respectively (Bryant and Matty, 1981). Larvae receiving the mixed diet were given dry feed at 800hrs. and 1100hrs while live feed was given at 1600hrs. to minimize the chances of dry feed consumption by food organisms. However, in the case of larvae receiving only dry diet, the daily dose was given in four installments

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namely, at 800hrs, 1200hrs, 1600hrs, and 1900hrs.

Experiment 2: Adaptation Weight

Carp larvae and post-larvae after feeding on cultured live-food organisms (*Ceriodaphnia)* from first exogenous feeding were shifted over to artificial dry diet at initial weaning mass of 2.5 mg, 9.2 mg, 15.2mg, 25 mg, 42.3 mg and 60.6 mg. The survival and growth was monitored over a period of 20 days to determine the age at which larvae thrive most successful on dry diet.

These experiments were conducted in glass troughs, 10 larvae per trough of 5 liter capacity with 10 larvae per trough. Water was changed every alternate day and each treatment was replicated.

The specific growth rate (SGR) of groups was computed by using the formula of Brown (1957) and normalized biomass index (NBI) was determined according to the formula of Beck (1979).

RESULTS

The results of experiments conducted showed that the larvae fed live cultured food organisms recorded maximum growth rate (Table-2). The normalized biomass index (NBI) was also the highest in larvae that received live-food and lowest in those that received mixed diet treatment D (Table-2)

The best results were with treatment set A as specific growth rate (SGR) was highest with live-food without any mortality. The results of treatment B&C in terms of SGR and survival success differed significantly from treatment D in terms of survival among mixed diet formulation (Fig. I).

Larvae that received only dry diet from day first of exogenous feeding survived 15 days the longest (Fig.I). These larvae consumed dry diet from day one of exogenous feeding but turned emaciated with passage of time and registered total mortality after the age of 15 days. ANNOVA revealed variation in respect of growth in larvae, reared under different treatments, significant at 1%.

SGR increased with the increase in initial weight of weaning to dry feed. The increase in weaning mass up to 15.2 mg (length 12.2mm) decreased mortality and increased SGR. The survival was 100 % while as SGR continued to increase with further increase in weaning weight. While SGR did not differ much among the groups that were weaned at initial weight of 15.2 mg and 25.8 mg (Fig.2) the survival of larvae was also 100% in both. Initial weaning at a mass below 15.2 mg resulted in high mortality and low SGR. The NBI increased with increase in the weaning weight of the larvae (Table-3)

It would thus appear that postlarvae with a weaning weight of 15 mg. and above have the ability to utilize dry feeds more efficiently than larvae of lower initial weaning weight.

DISCUSSION

The poor growth rate eventually leading to total mortality of carp larvae fed exclusively dry diet from day 1 of exogenous feeding as found during the present studies, is a serious problem in fish culturing. The acceptance of dry food does not appear to be a problem with carp larvae as food provided to the larvae was always found in the alimentary canal of the so-called starving larvae in the present study. Nor could the poor performance of carp larvae be attributed to the lack of digestive enzymes in the larval gut and hence inability to digest dry food in view of the new available evidence to the contrary in the finding of Ragyanzski (Kaushik, 1986) who has demonstrated the presence of proteolytic enzymes right from the very first stage in carp larvae and that those contributed by Zooplankton account for only one-fourth of the proteolytic activity in larvae (Lauf and Hofer, 1984). These findings rule out poor utilization as the only reason for mortality of larvae fed on artificial diets. Obviously, the reasons can be more than one. The high enzyme production stimulated by dry diets and their poor re-absorption in the hind-gut in larvae, resulting in the loss of body proteins (Hofer and Nasir-Ud-Din, 1985), absence of some essential nutrients in the dry diet necessary for the metamorphosis of fish (Flutcher, 1982) coupled with the leaching of essential amino-acids from dry diets once in water (Grabner et al., 1981) together offer plausible explanation for poor performance of fish larvae with artificial diets.

The best performance in respect of growth and

survival, as exhibited by carp larvae in this study, when reared exclusively on natural live prey substantiates the reports of Sharma and Chakrabarty, (1999) and Montchowiu et al., (2011). The superior nutrient quality of live feeds is hence undisputed. In this regard the efficient utilization of synthetic dipeptides and proteins in 1:1 ratio in the diet of carp larvae for better survival as reported by Kawasek et al., (2010) remains to be confirmed especially for large scale use and under different ecological conditions.

Although substitution of live-food by dry diets in different proportions lowered the mortality, the restricted ration of live-food restrained the growth of larvae. This falls in line with the findings of Szlaminska & Przybyl, (1986). However, we did not get additive effect on growth of larvae with mixed diet as suggested by these authors. Our results reveal that 50% substitution of live-food can be reasonably relied upon from the day 1st of exogenous feeding to ensure up to 85% survival with SGR of 18.3% per day.

The present study has also demonstrated that carp larvae can be successfully weaned at an initial mass of 15.2 mg or above to artificial diets of rice-bran and oil-cake (1:1) with 100% survival. Montchowui et al., (2011) also recommended the appropriate weaning age of African carp at 14 days post-hatching. Bryant and Matty (1981) reported 9.5 mg as adaptation weight for carp larvae to commercial trout diet with 80% survival. The higher weaning weight (adaptation weight of 15.2 mg.) demonstrated by carp larvae in the present study could be due to poor quality of dry diet (rice-bran and oil-cakes) in comparison to one used by Bryant and Matty, (1981) as presence of several toxins and anti-nutritional factors in mustard oil-cake stands already reported (Gohl,1981).

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Table 1: Different diet formulations given

Treatment sets	Percent live food	Percent dry diet
A	100	--
B	75	25
C	50	50
D	25	75
E	--	100

Table 2: Normalized Biomass Index in relation to relative diet substitution. Initial length: 5.7mm, initial wt.: 0.9mg

Treatments	Final length	S.D. ±	Final wt.	S.D. ±	NBI
A	30.5	2.5	395	105	39.4
B	24.5	1.5	155	55	13.8
C	22.7	1.1	105	15	8.8
D	20.5	2.5	85	15	4.1
E	7.0	0.3	25	0.2	-

(-) Mortality was 100% after 15 days

Table 3: Adaptation of *C. carpio* larvae to artificial dry diets

Average length at weaning (mm.)	Initial wt. at weaning (mg.)	S.D (mg.)	Final wt.(mg.)	S.D. (mg.)	NBI
7	2.5	0.4	5.0	2.3	-0.1
9.9	9.2	0.6	20.0	1.8	0.88
12.2	15.2	1.4	50.4	6.2	3.52
14.9	25.8	5.2	92.0	14.8	6.62
16.0	42.3	7.0	190.4	18.5	14.81
18.2	60.6	9.2	300.6	28.4	29.0

Fig.1 : Growth rate and survival success of carp larvae reared on different diet formulations

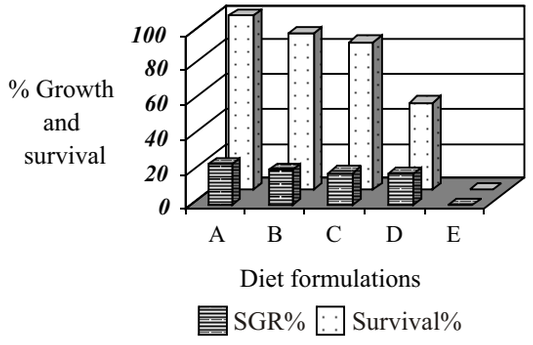
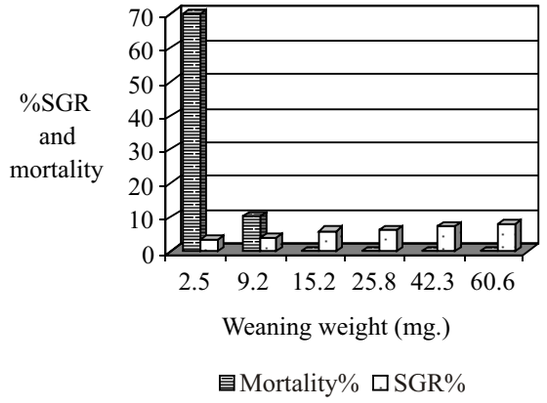


Fig. 2: SGR and mortality in carp larvae in response to weaning weaght



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