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Effects of different plant food on food utilization and energy budget in *Cyprinus carpio* (Linnaeus)

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ABSTRACT

In the present study we have evaluated effect of different plant diets on the amount of food consumption, absorbed, converted and metabolized in the fresh water fish *Cyprinus carpio*. We discussed the feeding rate, absorption rate, conversion rate and metabolic rate of fished when they consumed different foods, and the absorption and conversion efficiency were observed. The maximum absorption efficiency was observed in the potato fed fish and the minimum was observed in the radish fed fish. But maximum conversion efficiency was noticed in cabbage.

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Introduction

India is the second-largest aquaculture producer in the world. Like the largest producer, China, India's aquaculture is dominated by carp production: about 80% of India's aquaculture production is composed of carps of Indian and Chinese origin. Last 20 years, carp production has intensified in several parts of India and mixed feed comprising of rice bran and a plant protein source such as peanut oil cake or cottonseed oil cake is given to the fish (Anand *et al.*, 2006). Aquaculture is a booming activity in developing countries. If on one hand a worldwide increase of fish farming production has to be observed as an indubitable benefit for the conservation of the natural fish stocks, on the other it implies resource consumption and the supply of a huge quantity of waste and energy to the surrounding environment (FAO Fisheries Department, 2006). Developed a model for an instantaneous energy evaluation is aquaculture system, so that transformities, efficiency and effort spent at each moment during the fish rearing activity could be calculated. Introduction of fingerlings represented the highest contributions to the total energy budget. The energy approach can be used to improve management of a fish farm installation by assessing the variations of energy and transformities during the rearing process and detecting the phases of the process that most affect the energy value of a fish reared in the system structure examined (Vassallo *et al*., 2009).

Different practices, depending upon the variable inputs, semi-intensive carp culture practices in rural aquaculture involve utilization of various organic manures for plankton (natural food) production. These manures are either directly utilized by the fish or they enrich the aquatic ecosystem with autotrophic (plankton) and heterotrophic microbial communities (Muendo *et al*., 2006). Vermicompost manure increases the growth rate of common carp (Kaur and Ansal, 2010).

In aquaculture the feed is a most expensive input and account to 58.87% total recurring expenditure. Fleming (1983), observed the effects of plant and animal diet combinations of the utilization of the fresh water fish. Different technology have been employed in order to reduce the cost of feed, which often range from 40-50 aquaculture cost a commercial non hormonal growth promoter was evaluated through dietary administration in Common carp, for the growth promoting potential (Hanumanthappa *et al*., 2002). The use of plant protein used as dietary feed ingredients has great potential, because of the feasibility of producing good quality protein from tropical and subtropical plants (Nagay *et al*., 1978).

Fishes are more in nourishment in comparition to poultry eggs and flesh, in fish contain 13-20% of protein and have a food value of 300-600 calories in one pound of fish (Srivastava, 1988). The growth rate of fish is an important aspect in fisheries. The pressing demands for the low cost, protein rid food by the ever increasing population, especially in the devloping countries with the problems of the under tend malnutrition have abundantly convinced the need for the rapid establishment of aquaculture (Pandian and Vivekanandan, 1976). Aquaculture feed from the most expensive input and 57-87% of the total recurring expenditure (Nandeesha, 1993). The cost of fish feed through use of these alternative and less conventional raw materials would be ideal for protection farm based aqua feeds (Jana *et al*., 1998).

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 (Watanabe, 2002). Mazurkiewicz (2009) observed that domestic plant components are used for common carp diets. Mazurkiewicz *et al*. (2004) on feeding two-year old carp confirmed that it is possible to completely replace animal

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meal with a mixture of a few plant protein components (extracted soy bean and rapeseed meal, lupin seeds, and soy bean protein concentrate). A properly balanced diet based on plant protein alone requires supplementation with the crystalline amino acids. Tuladhar (2003) noticed that growth of the fish in three ponds with plant protein sources was significant than in the fishes of other ponds with fish meal diet. Soyabean 40% of protein supplied by SBM in fingerling carp diets without adverse effects on growth, specific growth ratios, protein efficiency ratios, feed conversion ratios and body weight gain (Buyukcapar and Kamalak, 2007).

Materials and methods

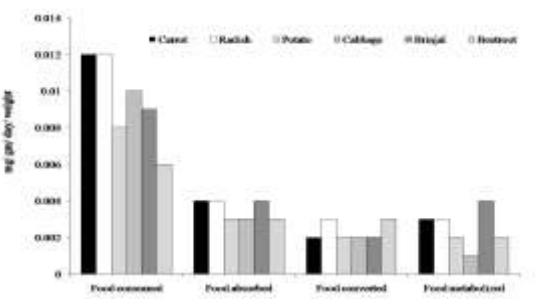
Fish procurement *Cyprinus crpio* fingerlings were procured from seed fish form, poondi near Chennai, India. The finger lings were acclaimed to laboratory condition for 15 days keeping them in rectangular glass aquarium (60 liter capacity). Proper aeration was provided with the help of suitable aerator. They were fed with boiled *Amaranthus gangeticus* and treated as stock individuals.

Fish feed

The feeding experiment was conducted in plastic container in which three fishes each were introduced. Ten fingerlings of the fishes were selected at randomly and weight to the estimated the initial dry weight of the test fishes (Maynard and Loosely, 1962), followed by sacrifice method. The present study plant food were provided viz Carrot (*Daucus carota*), Cabbage (*Brassica olevacea*), Brinjal (*Solanum melangiana*), Raddish (*Raphanus sativus*), Beetroot (*Beta vulgaris*), Potato (*Solanum tuerosum*) 2gm/day.

The unconsumed food and feces egested by fish were removed immediately before each feeding, dried and weight. The water in all the troughs was changed every day without causing any disturbance to the experimental specimen. The experiment was conducted for 30 days.

Figure 1 Overall energy budget of *Cyprinus carpio* fed on six different types of plant food for a period of thirty days.



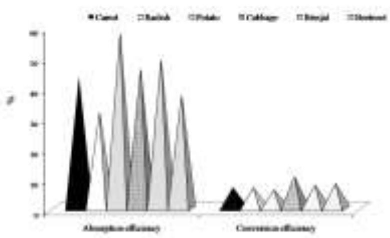
Results

At the end of the experiment on the fishes were oven dried at 60° C to estimate the final day weight of the fishes. Table 1 represent the overall energy budget of *Cyprinus carpio* fed on differnet types of natural diet of carrot, cabbage, brinjal, raddish, beetroot and potato, for 30 days, Among the plant feeds, the test fish had maximum consumption of 8.5g dry weight, when they fed beet root. Food consumption was lower when the fish was fed cabbage 4.8 g dry.

The maximum amount of food absorbed by the test fish fed on beetroot (3.17g dry weight). Low amount of absorption was noticed in when the fish was fed on cabbage 2.19 17gdry weight. The amount of food was converted for fish fed on beet root 0.70 mg/g/dry weight. The lowest value for food converted when test fish consumed potato 0.36 mg/g/dry weight. Data obtained for the amount of food metabolized was maximum in fish fed on brinjal and cabbage fed fish exhibited minimum value 1.69.

Table 2 showed feeding, absorption, conversion and metabolic rate of *C. capio*. The feeding rates test fish fed on carrot and radish are the maximum 0.012 mg/g/dry weight. The minimum was recorded in fishes fed beetroot 0.006. Absorption rates for the test fishes fed on cabbage, carrot and radish (0.04 mg/g/day weight). Conversion rate of the test fishes fed on radish and beetroot were found to be more (0.03 and 0.03 mg/g/day weight), when the food conversion rate was lower in other plant diet.

Figure 2 Influenced of different plant food on the efficiencies of absorption and conversion of *Cyprinus carpio*



Metabolic rate of the test fishes fed on brinjal was calculated and it was observed to be the maximum (0.04 mg/g/day/weight). Minimum rate was observed in cabbage. The intermediate metabolic rate was observed in fishes fed on carrot and radish. The table 3 shows absorption efficiencies ranged between (31.49-57.55%). The absorption efficiency was maximum in 57.55% for the fish fed on potato and minimum absorption efficiency 31.49% was revealed by the fish fed on radish. The maximum conversion efficiencies of fishes fed on cabbage minimum on potato fed fishes.

Discussion

Food consumed an organism mainly used for the maintenance of the body and for growth. Maintenance is mostly by utilizing carbohydrates and lipids, where as growth require proteins. To increase the weight organism a surplus amount of food energy above that need for maintaining itself. Energy utilization in a fish depends on a large number of biotic factors namely temperature is also equally important for energy utilization which deals the easy availability of food materials and the interaction of the other living beings. It is well known fact that growths rate of an organism various not only with quantity and quality of food but with environmental condition also previous studies reported that the growth rate of some of fish when fed on different type of food vary considerably (Fisher, 1970).

While Sinha and Ramachandran (1985) recorded upto 87% od survival of carp fry at stocking reported high survival rates of 84-96%. Swaminathan and Sigit (1982) obtained survival as high as 60% from spawn to fingerlings 72-80 mm size. The good survival to the tune of almost cent percent obtained in this study is mostly attributed to low stocking densities and complete eradication of other materials. Previous authors also reported variations in energy budget of fishes due to quality (Pandian and Raghuraman, 1972) and quality of food (Hanifa and Venkatachalam, 1980). In the present investigations also variation in every budget of *Cyprinus carpio communis* was noticed as function of quality food. The maximum feeding rate was (0.012mg/gm/day) for *Cyprinus carpio* fed on carrot and raddish. The minimum feeding rate was 0.006 and authors, for instance (Pandian and Rahuraman, 1972) reported 28mg/g/day feeding rate for *Tilapia mossambica*.

According to Vivekanandan *et al*. (1977) feeding rate of Anabas scandens ranged from 6.32-29.3 mg/g/day. Fleming (1983) reported (14.9-194.4 mg/g/day) feeding rate of *Labeo rohita* fed on different kinds of plant, animal and mixed diet. Hanifa and Venkatachalam (1980) suggested omnivorous diet for a rapid growth rate in fishes. Jhingran *et al*. (1979) reported that successful fish feed include palatability, high conversion value, abundant availability and low cost. The choice of food items for the experiments was based on those considerations. The items are also valuable as their nutritive value is as close as possible to natural food. The present investigation six type of plant feed, used the *Cyprinus carpio* is having feeding performance of beetroot and the minimum preference towards cabbage.

Swain *et al*. (1999) reported the growth and survival rates decreased with increasing stocking densities. The average weight in 80 and 100 million were 38-30 mg respectively. The present investigation, maximum feeding and absorption rate were noticed in carrot, radish and minimum in beetroot, cabbage and potato. According to there was no growth carp fed on plant food and drew a conclusion that exclusively plant food must lead to death of fish. Maximum conversion rate was in *Labeo rohita* fed cent percent plant food, the same was those fed on 50% plant food and 50% animal food. It is cleared that not only feeding rate 3-6 times greater in combination of animal and plant food. The present investigation showed maximum conversion rate in radish and beetroot and minimum in other plants diet. According to Hanifa and Venkatachalam (1980) the absorption efficiency was more in plant diet, when compared with animal diet. In the present investigation, the maximum and minimum absorption efficiency of 57.55% and 31.49 were in potato and radish. According to Ricklefs (1973), absorption efficiency is largely depending by the quality of food. Fleming (1983) stated that maximum conversion efficiency in less than 25% was noted by *L. rohita* when fed on plant diet, the same was less than 10% in animal diet. Vivekanandan *et al*. (1977) reported that absorption efficiency was increased at same time conversion efficiency was decreased. The same trend was observed in the present investigation.

Benakappa and Varghese (2003) are of opinion that the growth realized (conversion efficiency) is depending upon the dietary requirements of the fishes. In the present investigation the fishes fed on cabbage exhibited maximum conversion efficiency against highest absorption efficiency. Similarly the growth realized in fishes fed with beetroot was measured as 8.17% conversion efficiency against 37% absorption efficiency. Therefore it may be concluded that cabbage followed by beetroot diet contain dietary requirement of the given fish species *Cyprinus carpio*. The vast differences observed between absorption efficiency and conversion efficiencies in the present investigation may due to the pattern of distribution and activities of digestive enzymes in the digestive tract of the test species (Sethuramalingam and Haniffa, 2002).

The absorption efficiencies obtained in the present study which range between 31.49% and 57.55% are found be comparatively lower than the efficiencies obtained by Patnaik *et al*. (2002) with plant doet on *L. rohita*. But convertion efficiencies are extremely high with the diets used in the present study. Bindu and Sobha (2004) reported the maximum food conversion efficiency when the fresh water carp *L. rohita* fed on fish meal. The present investigation showed the maximum absorption efficiency and minimum conversion efficiency was observed when tested fish fed on potato and cabbage.

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Table 1 Overall energy budget of *Cyprinus carpio* fed on six different types of plant food for a period of thirty days.

Food provided	Food consumed	Food absorbed	Food converted	Food metabolized
Carrot	5.53 ± 0.002	2.41±0.037	0.39±0.023	2.38±0.039
Radish	7.08±0.008	2.23±0.06	0.48±0.025	1.75±0.036
Potato	5.89±0.007	3.39±0.018	0.36±0.021	3.03±0.018
Cabbage	4.79±0.009	2.19±0.011	0.50±0.016	1.69±0.033
Brinjal	7.77±0.006	3.79±0.013	0.60±0.025	3.19±0.019
Beetroot	8.55±0.007	3.17±0.02	0.70±0.028	2.47±0.042

Value are represented as mean ± SD