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Alternative dietary protein source for nile Tilapia: Giant African Snail (*Achatina fulica*, Ferussac, 1821)

Archana Prasad and Karishma Chaudhary

Central Department of Zoology, Kirtipur, Kathmandu, Nepal
E-mail: archanaprasad001@gmail.com

Abstract
The present study was conducted for two months between November 2019 and December 2019 to investigate the growth performance of Nile Tilapia fed with diets containing soyabean 100% (T1), soyabean and *Achatina fulica*: 50/50% (T2) and *A. fulica* 100% (T3). The experimental diets were formulated with 45% crude protein content. The stocking density was 30 fingerlings per tank of size 1m*1m*0.8m with three replications for each treatment. The tanks were stocked with the fingerlings of uniform size 9 ± 677 cm and weight 24 ± 0.66g. The experimental fishes were fed twice a day at 5% of their body weight. No significant differences (p>0.05) in average weight gain, apparent feed conversion ratio (AFCR), daily weight gain, gross fish yield and net fish yield were observed. The study revealed that Giant African Snail (GAS) can be used either as partial or total replacement for soyabean as protein source for the fish. The use of harmful pest *A. fulica* in fish feed shows bright prospect in reducing the feeding expenses together with its suitable management.

Key words: *Achtina fulica*, Crude Protein, Giant African Snail, Nile Tilapia, Soyabean.

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Introduction

Nepal has wide varieties of water bodies lying at altitudes ranging from 60 m to 8848 m which facilitate good commercial culture of varieties of fishes with little supplementary feeds. Fish is excellent source of protein essential for overall development of body. About 1 billion people worldwide rely on fish and fish products as primary source of animal protein (FAO, 2000). But, Nepal has comparatively least per capita fish consumption i.e 3.39 kg (CFPCC, 2018). Aqua culturists mainly use locally available feed materials such as rice bran, soybeans, wheat flour, mustard oilcakes etc. Various plant, animal and bio waste origin ingredients have been used in nutritional studies in order reduce feeding expenses and produce high quality feed such as pupae and worms (Hilton, 1983), fresh and dry fish (Castaneres, 1990), legume seed (Keembiyehetty, 1993), fodder plants, oilcake and oil meals, aquatic weeds (EI-Sayed, 1999, Fasakin et al., 2003)), hydrolyzed poultry feathers (Abdel-warith *et al*., 2001), insects (Fasakin *et al*., 2003), blood, earthworms (Gosh, 2004, Rawling *et al*., 2012;), roots and tubers (Tusche et al., 2013), fish silages, milk by- products, kitchen by-products and slaughter house by-products (Cheng *et al*., 2015)cereal and cereal by-products (Santis *et al*., 2016). Some miscellaneous sources like cane molasses, brewer's yeast, leaf protein concentrate, grain distiller by-product, fats, algae, yeast, bacterial protein etc were also investigated (Ran and Zhou, 2016, (Feedipedia, 2018).

GAS acts as invasive pest among the

nine exotic molluscs in Nepal and is spreading mainly due to its beautiful shell (Budha and Naggs, 2008) and transportation with agro products. The typical adult shell is conical shape mostly of light to dark brown with vertical stripes of darker brown shades. Predators and unfavorable climatic condition are the major causes of its mortality (Raut and Barker, 2002). They are mainly herbivorous consuming wide variety of plants, but also found feeding on dead moist leaves (White, 2011). Florida estimated annual loss of $11 million if GAS is left unchecked (USDA, 1982). Thus, it is one of the burning problems for agriculturists. It also creates threats to native molluscs and acts as intermediate host of various diseases like Black disease of cacao, Abdominal Angiostrongyliasis, Schistosomiasis etc. (EOL, 2015). It has high protein content (above 40%), low fat (less than 3%) and relatively a good source of Iron, calcium, but is poor in phosphorous, magnesium, potassium (Abaou, 1990).

Nile Tilapia has regular and definitive stripes on caudal and dark margin on dorsal fins as its distinguishing characteristics. Its body colora-tion varies depending on environmental, physio-logical and dietary factors (Macintosh and Little, 1995). Although herbivorous, it also feeds on aquatic insects, crustaceans, fish eggs and organic debris (Khallaf and Alne-na-ei, 1987). Nile Tilapia is considered as one of the most suitable commercial aquaculture species in subtropical and tropical region at it has best protein digestibility (Stickney, 1997).

Materials and Methods

Experimental site

Present experiment was conducted at Fishery Research Unit of Regional Agricultural Research Station (RARS), Parwanipur, Bara. It is situated at 2 km east from Parwanipur Chowk which lies in highway to Birganj.

Feed preparation

Fish feed with 45% crude protein concentration was prepared using locally available materials like rice bran, wheat flour, mustard oil cake and soybean and/ or fine powdered *A. fulica* by Pearson Square Method (Table 1). The formulated diet was supplemented with 1% vitamin and mineral. The fishes were given the three treatments (T1, T2 and T3) which were formulated as: T1: Normal ingredients + 100% Soybean, T2: Normal ingredients + 50/50% Soybean and *A. fulica*, and T3: Normal ingredients + 100% *A. fulica*.

Table 1. Crude protein contents of feed ingredients.

SN	Ingredients	Crude protein content (%)
1.	Rice bran	15
2.	Mustard oil cake	28.80
3.	Wheat Flour	13.70
4.	Soybean	37.00
5.	Dried *A.fulica*	46.60

Experimental set up

Nine cemented tanks each measuring 1m x 1m x 0.8m were used for the experimental purpose. The tanks were supplied with continuous bored tube well water in sprinkle to maintain water level at 0.8m. Each tank was provided with plastic feeding trays for feeding purpose. The tanks were stocked with the fingerlings of uniform size 9 ± 677 cm and weight 24 ± 0.66g. The tanks were stocked one day prior the treatments for acclimatization and the tanks were stocked with 30 fingerlings per tank. Thus, altogether 270 fingerlings were stocked.

Feeding and data collection

The fingerlings were fed with 5 % of their body weight, twice a day, at 8.00 am and 4.00 pm for two months. Growth check was done every 15 days in morning. Mortality was also recorded. Feed quantity was adjusted after every 15 days in accordance with the average fish weight. Daily weight gain, Apparent feed conversion ratio (AFCR), Net fish yield, Gross fish yield, and Survival rate were recorded.

Statistical analysis - One way ANOVA was performed to test the significant differences among the treatments. The probability level was set at 0.05.

Results

Growth pattern

The fishes showed slight difference in the growth patterns at different treatments with highest growth performance in T2 and the lowest performance in T3 (Figure 1).

Figure 1. Average weight of fish in different treatments during sampling.

Apparent feed conversion ratio (AFCR)

The AFCR on 2nd November at T1, T2 and T3 were 3.09, 2.17 and 2.32 respectively (Figure 2). AFCR for all the treatments showed increasing trend with higher trends for T1 and T3 (Figure 2). During the next 30 days the AFCR showed similar increasing trends for all the treatments. However, AFCR showed noticeable hike during the last 15 days for all the treatments.

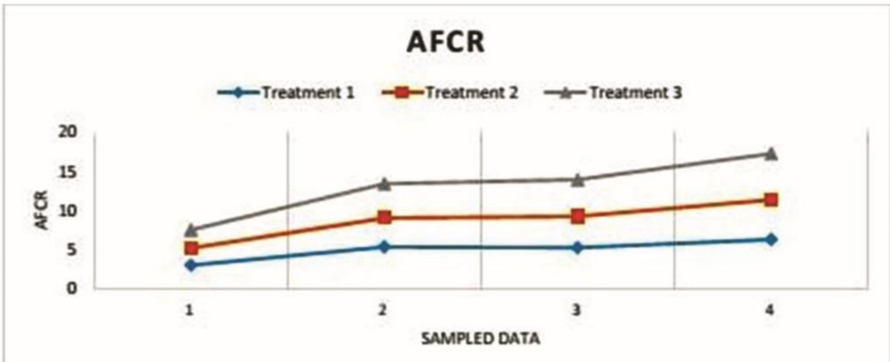

Figure 2. Apparent feed conversion ratio (AFCR) at different treatments.

Daily weight gain (DWG)

The average daily weight gain showed alternate increase and decrease at 15 days interval during the study period (Figure 3).

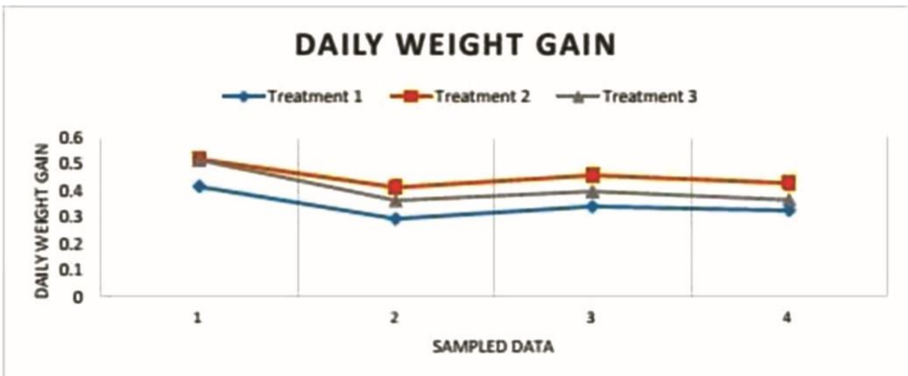

Figure 3. Daily weight gain of fish at different treatments.

Growth and Production

There was no significance difference ($p>0.05$) in average weight gain, AFCR, daily weight gain, gross fish yield and net fish yield. The average initial weight of individual fish was 24± 0.66 g during stocking. Mean stocking weight was in the order of T1, T3 and T2 (25.688g, 23.966g and 22.54g respectively). The total harvesting weights were in the following order: T2 (933.958 g), T3 (910.833 g) and T1 (868.75 g). Gross fish yield was higher in T2 (1.8938 kg/m2/yr) and lower in T1 (1.7616 kg/m2/yr). Net fish yield was 0.7849 g, 1.036 g and 0.9357 g in T1, T2 and T3, respectively. Average daily weight gain was 0.344 g, 0.454 g and 0.410 g in T1, T2 and T3, respectively. The AFCR was highest in T1 (5.052) and lowest in T2 (3.723). The survivability rate was 100% with zero mortality in all the treatments (Table 2).

Table 2. Growth and Production parameter in different treatment

Parameters	T1	T2	T3
Mean stocking weight (g/fish)	25.688	22.544	23.966
Total stocking weight (g/m^3)	160.555	140.902	149.791
Mean harvesting weight (g/fish)	46.333	49.8111	48.577
Total harvesting weight (g/m^3)	868.75	933.958	910.833
Gross fish yield (kg/m^2/yr)	1.7616	1.8938	1.8469
Net fish yield (kg/m^2/yr)	0.7849	1.0367	0.9357
Average DWG (g/day/fish)	0.344	0.454	0.410
Survival (%)	100	100	100
Feed conversion ratio	5.052	3.723	4.318

Disscusion

No significant difference in average weight gain, AFCR, daily weight gain, gross fish yield and net fish yield in Nile Tilapia fed with GAS (*A. fulica*) as their alternative dietary protein source suggested that soybean can be partially or totally be replaced by *A. fulica* as the protein source for the fish. The result agreed with the finding of Abarra and Ragaza (2017) who replaced fish meal with processed Knife fish *Chitala ornata* with high caloric contents in Nile Tilapia juvenile and found partial or total replacement mainly with 75% *Chitala ornata* increases the average weight gain, specific growth rate and feed intake.

The result of the present study agreed with Rawling et al. 2012 who reported on the positive response of mirror carp fed with tropical earthworm meal. They attributed this to the high protein content (50-70%) in the earthworm meal. Poultry by-product meal with high protein content ranging from 75-90% with relatively low content of ash (less than 10%) and fat (less than 15%) showed significant results as compared to the fish meal based control diet with 40% of protein content (Abdel-warith et al., 2001).

Several workers have reported on varying results regarding the response of fishes toward the alternative sources of protein. Hilton, 1983 reported that the trout fed with fish meal containing freeze-dried worm as an alternative dietary protein source showed negative growth performance. On contrary, Cheng *et al.*, 2015 reported that the carps (*Ctenopharyngodon idella* and *Cirrhinus molitorella*) fed with different food waste and meat meal as protein sources produced high quality flesh.

The AFCR in all the three treatments was almost same which might be resulted due to maximum feeding and some environmental condition in all the tanks.

In the present study, the growth performance of Nile Tilapia fed with *A. fulica* protein was not significantly higher which might be attributed to its low level of fat (less than 3%), phosphorous, potassium and magnesium (Abouo, 1990).

Conclusion

The present feeding trial on Nile Tilapia replacing soybean with Giant African Snail (*A. fulica*) showed no significant difference among the growth parameters like average weight gain, apparent feed conversion ratio, daily weight gain, gross fish yield and net fish yield. The survivability rate was found to be 100% with zero mortality for all the treatments. Hence, it was concluded that *A. fulica* could be successfully used as partial or total replacement for soyabean as the protein source for Nile Tilapia. The use of harmful pest *A. fulica* in fish feed shows bright prospect in reducing the feeding expenses together with its suitable management.

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