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Growth of Tinfoil Barb, *Puntius schwanenfeldii*, Fed Various Feeds, Including Fresh Chicken Manure, in Floating Cages

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Abstract

The effects of feeding various combinations of fresh and prepared feeds on growth of tinfoil barb, *Puntius schwanenfeldii*, was examined. The partial replacement of pellet feed with fresh chicken manure was also studied. Specific growth rates (% SGR) were best when fish were fed commercial pellets (0.35-1.50) and grated cassava tubers or bananas with dried fish and water spinach leaves (1.02 and 0.59-0.83, respectively). Food conversion ratios (FCR) of these feeds were also the lowest (1.3-7.5, 5.6 and 7.2-7.8). Leaves of the cassava and of a local climbing plant, *Passiflora* sp., also resulted in adequate growth (0.39-0.44 and 0.22) and better than expected food conversion (FCR: 8.4-12.3 and 18.3). Growth of fish that were fed pellet feed and had access to fresh chicken manure was not significantly different from that of fish fed entirely on pellets (% SGR: 0.4 and 0.44), but food conversion was significantly lower (FCR: 2.8 as opposed to 4.0).

Introduction

The java carp *(Puntius gonionotus)* is a well-known and popular Asian pond fish (Hickling 1962) that does not occur in East Kalimantan, Indonesia. It is closely related to the tinfoil barb *(P. schwanenfeldii)*, which is omnivorous (Vaas 1953; Yap 1983), attains at least the same size as java carp (Djajadiredja et al. 1977) and occurs naturally over a wide range of freshwaters in Southeast Asia. In spite of this, the suitability of tinfoil barb as an alternative to java carp has not been investigated by many authors (Mohsin and Kok-Jee 1979).

This study reports on the growth of tinfoil barb in floating cages using on-farm and commercial feeds, as well as chicken manure as a partial feed replacement.

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Materials and Methods

A total of 15 floating wooden cages with submerged volumes of 1.5-1.6 m^3 (1.5 x 1 x 1 m deep) and two cages of 5.2 m^3 (2.6 x 2 x 1 m deep) were used. The cage station was located in Kota Bangun on the Mahakam River in East Kalimantan (Christensen 1992). The experiments were conducted between 1983 and 1987. Water quality was determined daily for one year as well as at random intervals between 1979 and 1988 and was found to be optimal for fish growth: temperature 27.0°C (20.4-31.3), oxygen 6.0 $mg \cdot l^{-1}$ (3.1-11.4), pH 6.6 (5.0-7.5), transparency 24 cm (11-84), total hardness 1.2 °dH (0.5-2.4), and conductivity 54 μS (23-95) (Christensen 1992). Ammonia, nitrite and nitrate were rarely detectable and levels were always much lower than those required for healthy fish growth (Boyd 1982; Meade 1985; Lewis and Morris 1986).

Wild juvenile tinfoil barb were caught in rivers and lakes using castnets and traps within 15 km of the station as hatchery-bred stock was not available. Fish were stocked in floating cages at densities of 140 $fish \cdot m^{-3}$. After a two- to three-week acclimatization period, stocking densities were reduced to the optimum level of 120 $fish \cdot m^{-3}$ (Christensen 1991).

During acclimatization, fish were fed to satiation twice daily, six days a week with a commercial pellet feed with a 25-28% protein, 6-8% fat, 2,500-2,800 $kcal \cdot kg^{-1}$ energy and 22-23% moisture content. The maximum daily ration for home-made and commercial pellets was equivalent to 4% of total body weight until fish attained an average weight of 50 g, 3.5% until they weighed 100 g and thereafter 3%.

Bundles of leaves of water spinach *(Ipomea aquatica)*, the rubber tree *(Hevea brasiliensis)*, cassava *(Manihot esculenta)* and of a locally-common climber *(Passiflora* sp.*)* were placed directly in the cages. Cassava tubers were grated and cooking bananas peeled and broken into small pieces before being fed; dried fish were fed directly. Maximum rations of leaves were equivalent to 9% of body weight, of fresh feeds to 4%.

The total weight of all fish in each cage, their number and the individual weight and length of a sample of 50-60 fish were determined at 3-4 week intervals. The latter data were used to calculate condition factors.

Partial replacement of commercial pellet feed with fresh chicken manure was tested by constructing a chicken coop above one of two cages. This allowed fish to feed on whatever manure fell into the cage. The chicken coop was divided into two sections and each stocked alternately every four weeks with 20 broilers (white leghorns). Chickens were harvested every eight weeks. This cyclic stocking and harvesting of "two" coops over the cage ensured that the amount of manure available did not change too greatly over time, as both young and older chickens were always present. The chickens received pellet feed, a vitamin/mineral mix and vaccinations according to standard methods.

The weight of manure falling into the fish cage was estimated by placing a plastic sheet under the coop for a 24-hour period. Manure production was related to chicken size using Model-II regressions and the total amount of manure available to the fish during the culture cycle of 340 days estimated.

Results

Culture data of fish fed 17 different feeds and feed combinations are given in Table 1. Growth data for fish with and without access to fresh chicken manure are given in Table 2. Changes in feed conversion ratios (FCR) for all fish and in condition factors of the subsamples of 50-60 fish are shown in Fig. 1.

The availability of chicken manure had no significant effects on either growth or mortality. However, the condition factor of fish with access to manure decreased until the fish reached a size of 180-200 g and only improved thereafter, whereas that of the other fish increased slowly, but constantly throughout (Fig. 1). FCR values were similar in both groups, but significantly better for fish with access to manure after they had reached a size of about 160 g (Fig. 1).

A linear relationship was found for the production of chicken manure (PCE) on chicken weight (CW):

$$PCE = 8.7512 + 0.07323\ CW\ (N = 24,\ r = 0.971)$$

Chicken excrements made up 92-94% of the manure, pellet feed the remainder. Based on this, it was estimated that 818.2 kg manure fell into the cage during the culture period. When corrected so that the moisture content was equal to that of pellets (22% moisture), then it is equivalent to 370.1 kg manure, as these contained 66.4% moisture. Feed conversion of pellets plus manures is thus 5.4, if it is assumed that the fish consumed all the manure, as 401.8 kg pellets were given and the weight increase of fish was 142.2 kg. In fact, the FCR is probably even better than this, because some of the manure was undoubtedly lost.

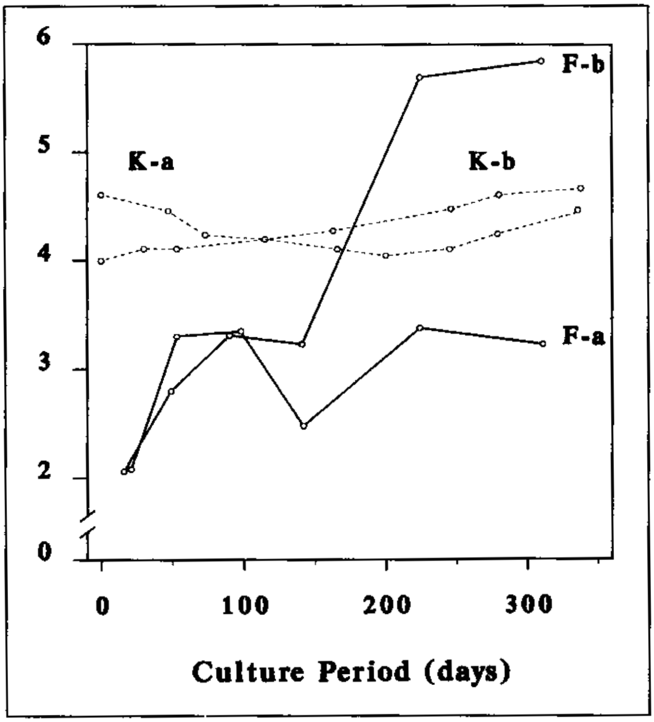

Fig. 1. Food conversion ratio (F) and condition factor (K) of tinfoil barb, *Puntius schwanenfeldii*, fed a commercial pellet feed and that either did (a) or did not (b) have access to fresh chicken manure.

Discussion

Tinfoil barb have potential as herbivorous aquaculture candidates, as they utilize cassava and *Passiflora* leaves very efficiently (FCR 8.4-18.3) when compared to most other herbivorous fish (Edwards 1987). Rubber and water spinach leaves were not utilized efficiently, though, possibly due to antinutritional factors - rubber tree leaves contain prussic acid and water spinach can induce diarrhea in vertebrates (Göhl 1981).

The efficiency with which tinfoil barb utilize cassava and *Passiflora* leaves is underlined when compared to the best-known herbivore, grass carp. FCR values for grass carp generally lie between 30 and 200 (Venkatesh and Shetty 1978; Edwards 1980; Shireman and Smith 1983), although they do utilize duckweed more efficiently (Edwards 1980). It has been said that "because there are constraints to the use of grass carp in the tropics, ... other macrophagous fish such as ... the tropical carp, *Puntius gonionotus*, require evaluation in polyculture" (Edwards 1987, p. 311). The results of the present study confirm that the closely-related *P. schwanenfeldii* should also be assessed as it utilizes the leaves of some plants very efficiently. Leaves of other promising plants, e.g., *Azolla* spp. *Lemna* spp. and *Wolffia* spp. (Edwards 1980, 1987; Almazan et al. 1986; Naskar 1986), were not tested in the present study as their mass production was difficult in the project area where flooding is an annual occurrence (Christensen 1992).

Several other feeds resulted in good growth of tinfoil barb, among them combinations of grated cassava tubers or bananas with dried fish or pellets and water spinach leaves (Table 1). FCR rates were also acceptable, making them

Table 1. Culture data for tinfoil barb, *Puntius schwanenfeldii*, reared on various feedstuffs.

Feed type	Feed composition (%)	No. of trials	Culture period (days)	No. of fish	Fish weight (g)	Specific growth[a]	Food conversion ratio[b]
Rubber tree leaves	100	1	28	62	91-92	0.04	42.1
Cassava leaves (CL)	100	2	28	61	98-113	0.39-0.44	8.4-12.3
Water spinach leaves (WSL)	100	1	125	62	107-114	0.06	232.7
Passiflora sp. leaves	100	1	28	271	109-117	0.22	18.3
Cassava tubers (CT) and CL	76-24	2	28	62-64	84-93	0.23-0.34	12.6-50.1
CT and WSL	79-21	1	126	281	48-62	0.20	60.2
CT, CL and pellet feed	68-19-13	1	28	62	95-111	0.54	7.0
CT, CL and dried fish	71-14-15	1	28	62	104-116	0.37	10.1
Bananas and CL	73-27	2	28	56-62	80-139	0.13-0.26	18.5-37.6
Bananas and WSL	84-16	1	123	265	39-58	0.32	64.6
CT, dried fish and WSL	69-14-17	1	85	257	62-148	1.02	5.6
Bananas, dried fish and WSL	74-19-7	1	87	223	58-119	0.83	7.8
Bananas, dried fish and WSL	50-22-27	1	171	170	24-67	0.59	7.2
Pellet 1[c]	100	1	28	60	121-143	0.58	6.0
Pellet 2[d]	100	1	210	269	74-142	0.31	5.4
Commercial pellet 1[e]	100	8	28-342	61-634	47-327	0.35-0.77	2.9-7.5
Commercial pellet 2[e]	100	8	46-85	31-117	41-144	0.41-1.50	1.3-6.1

[a] Specific Growth: (($\log_e$.Final wt. - $\log_e$.Initial wt.)/No. days) x 100

[b] Food conversion ratio: g food ingested/g weight increase

[c] Pellet 1: 10% dried fish, 35% dried shrimp, 20% rice, 15% cassava tubers, 20% cassava leaves, 1% vitamin/mineral mix

[d] Pellet 2: 40% fresh fish, 10% dried cassava tuber, 40% maize meal, 10% cassava leaves

[e] Analyses of 1 & 2: 25% and 26.5% protein, both 7% fat, 6% and 5.5% fiber, 6.5% and 8.5% ash, 2,700 and 2,650 kcal/kg energy

useful for small-scale farmers. Tinfoil barb grew best when fed commercial pellets, but this is to be expected of a balanced feed (Hepher 1988).

In addition, tinfoil barb grew equally well whether or not they had access to fresh chicken manure, but the amount of pellet feed required was significantly reduced in the presence of manure (Table 2, Fig. 1). Tinfoil barb thus appear to be able to utilize fresh chicken manure directly as feed, as has also been shown for channel catfish (Lu and Keveren 1975) and mullet (Leray 1970 *in* Kerns and Roelof 1978). The savings in ration is of considerable importance as feed makes up 50-70% of total costs incurred when culturing fish in floating cages (Beveridge 1987; Christensen 1991). Tinfoil barb appear, however, to be able to utilize manure only after reaching a certain size, as FCR and fish condition first improve when they attain 150-180 g (Fig. 1). The growth of tinfoil barb is similar to that of *P. gonionotus* (Wee and Ngamsnae 1986). It is not as good as that of other local cyprinid fish, e.g., jelawat carp *(Leptobarbus hoevenii)* (Pathmasothy and Omar 1982; Law 1984), and common carp (Beveridge 1987, Little and Muir 1987; Hepher 1988). In spite of this, tinfoil barb have potential in polyculture systems and the fact that feed can be partially replaced with fresh chicken manure is of significance.

Table 2. Culture data for tinfoil barb, *Puntius schwanenfeldii,* being fed a commercial pellet feed and either with or without access to fresh chicken manure.

Experimental data	Access to fresh chicken manure	
	With	Without
Culture period (days)	341.00	342.00
Number of fish	604.00	634.00
Initial weight (g)	89.00	73.30
Final weight (g)	343.80	326.90
Mortality (%)	5.60	5.40
Specific growth rate*	0.39^{a}	0.437^{a}
Food conversion ratio**	2.83^{a}	4.01^{b}

Values in the same row with different superscripts differ significantly ($P < 0.05$).

*SGR: (($\log_e$.Final weight - $\log_e$.Initial weight)/No. days) x 100.
**FCR: g feed consumed/g weight increase.

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