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Effects of Live Food Organisms and Formulated Diets on Growth, Survival, and Body Protein of Asian Sea Bass Fry (*Lates calcarifer*, Bloch)

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Key words: *Lates calcarifer*, *Artemia*, *Moina*, *Tubifex*, Bombay duck fishmeal, formulated diet, body protein

Abstract

The effects of the live feeds, *Artemia*, *Moina*, and *Tubifex*, and a formulated diet on the survival, growth, and body composition of fry (0.05±0.001 g) of the Asian sea bass, *Lates calcarifer* (also called barramundi), were evaluated. The formulated diet was supplemented with dry Bombay duck fishmeal (10%) as an attractant. The experiment was conducted for 30 days in 40-l glass aquaria containing 30 l fresh water. The fry fed *Artemia* had the best survival (70%) and growth rate (6.48±0.10%). Fry fed *Moina* and formulated diet had 60% survival, not significantly different from fry fed *Artemia*. Survival was poor (30%) in fry fed *Tubifex*. Body protein and lipid contents differed significantly among treatments. The present study suggests that *Artemia* nauplii is the better feed for Asian sea bass fry but formulated diet can be used as a substitute since growth and survival were similar.

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Introduction

Asian sea bass, *Lates calcarifer*, also called barramundi, is one of the commercially important euryhaline fishes in the Indo-Pacific and Australian regions. An obstacle to the mass production of Asian sea bass fingerlings is high mortality owing to cannibalism during larval stages when the feed quantity is deficient. The success of larval rearing depends mainly on the availability of suitable diets that are readily consumed, efficiently digested, and provide the nutrients required to support good growth and health (Giri et al., 2002). Sea bass fry prefer live food, which is many times difficult to provide. Formulated diets are easier to prepare and have lower production costs (Jones et al., 1993; Person-Le Ruyet et al., 1993), but the acceptance of formulated diets is poor compared to live food organisms. To overcome the acceptance problem, attractants can be incorporated into feeds (Carr, 1976; Mackie, 1982; Borquez and Cerqueira, 1998; Singh et al., 2005).

In the present study, a formulated diet was enriched with Bombay duck fishmeal (10%) as an attractant and compared with three live foods, *Artemia*, *Tubifex*, and *Moina*. Growth and survival data are powerful tools for understanding the effects of live and formulated diets on fish (Canavate and Fernandez-Diaz, 1999). The protein content in the fish body is a reliable index for estimating the nutritional condition of fish after feeding different diets (Gwak and Tanaka, 2002).

The objective of the present experiment was to evaluate the efficacy of formulated feed vis-a-vis live food on growth, survival, and protein content of fry of the Asian sea bass.

Materials and Methods

Sea bass fry were procured from a natural seed collection center in the Raigad district of Maharashtra, India, and acclimated to laboratory conditions for one week on an artificial diet. The experiment was conducted for 30 days in 40-l aquarium tanks (0.45 x 0.30 x 0.30 m) containing 30 l fresh water. Fry (0.05±0.001 g) were stocked at the rate of two per liter, with five replicates of each treatment. Temperature, dissolved oxygen, and pH were recorded daily. Temperature was measured with a digital thermometer (-50 to 200°C range; Superfit, India), dissolved oxygen by the titration method (APHA, 1985), and pH using a pH Scan 1WP1 (range 1.0-15.0, accuracy ±0.2; Eutech Instruments Pvt. Ltd., Singapore).

Four treatments included three live foods (*Artemia*, *Moina*, minced *Tubifex*) and one enriched formulated moist diet (Table 1). *Artemia* cysts were hatched in a glass jar in the laboratory of the Taraporevala Marine Biological Research Station and nauplii were used for feeding. *Moina* and *Tubifex* were obtained from a nearby aquarium shop and used as the sole food source after washing in fresh water. Fry were fed *ad libitum* twice a day.

Growth and survival were recorded at the end of the experiment. Initial and final protein

Table 1. Composition of the enriched formulated diet.

Ingredient	*%*
Casein	31.0
Soya bean meal	31.0
Rice bran	11.5
Gelatin	2.1
Carboxymethyl cellulose	5.0
Vitamin mix	2.5
Cellulose	1.5
Cod liver oil	5.4
Bombay duck fishmeal	10.0
Proximate composition	*% dry diet*
Protein	44.95
Fat	8.46
Moisture	15.00
Ash	5.0

and lipid contents of the fry were determined as per standard methods (AOAC, 1983). Data were statistically analyzed using one-way analysis of variance (Snedecor and Cochran, 1967). Duncan's multiple range test was used for multiple comparisons. Differences were regarded as significant at $p<0.05$.

Results

There were no significant differences in water temperature or pH between treatments (Table 2). However, dissolved oxygen was significantly lower in the *Tubifex* treatment. Growth rate and survival of fry fed *Artemia* was better than in fry fed other diets (Table 3). Body protein and lipid were highest in the fry fed *Artemia* and lowest in the fry fed *Tubifex* (Table 4).

Discussion

Growth and survival of fish fed *Artemia* were superior, similar to the growth pattern in an earlier study (Maneewong, 1986) and to results in larvae of yellow catfish, *Pelteobagrus fulvidraco* (Wang et al., 2005). In the present investigation, *Tubifex* were poorly accepted and unutilized

Table 2. Average water parameters during experimental period.

Treatment	*Temperature (°C)*	*Dissolved oxygen (ppm)*	*pH*
Tubifex	28.6±1.00	3.95±0.02[a]	7.45±0.10
Moina	28.5±1.00	5.30±0.01[b]	7.65±0.2
Artemia	28.4±1.00	5.70±0.02[c]	7.6±0.10
Formulated feed	28.5±1.00	5.25±0.03[d]	7.5±0.20

Values in a column with different superscripts differ significantly ($p<0.05$).

Table 3. Growth and survival of Asian sea bass fry fed different diets.

	Diet			
	Tubifex	*Moina*	*Artemia*	*Formulated feed*
Initial wt (g)	0.05±0.001	0.05±0.001	0.05±0.001	0.05±0.001
Final wt (g)	0.25±0.02	0.28±0.01	0.35±0.01	0.27±0.01
Wt gain (%)	400±0.00[a]	460±0.50[b]	600±2.00[c]	440±9.00[d]
SGR (%/day)	5.36±0.10[a]	5.74±0.20[b]	6.48±0.10[c]	5.62±0.15[d]
Initial length (cm)	1.0±0.02	1.0±0.02	1.0±0.02	1.0±0.02
Final length (cm)	2.5±0.10	3.0±0.15	3.2±0.10	2.7±0.20
Length gain (%)	150±0.50[a]	200±9.50[b]	220±2.20[c]	170±1.50[d]
Survival (%)	30±2.50[a]	60±2.80[bc]	70±3.00[bc]	60±2.50[bc]

Values in a row with different superscripts differ significantly ($p<0.05$).

Table 4. Body composition (mean±SE) of Asian sea bass fry at the start and end of the experiment.

	Initial body composition	*Final body composition*			
		Tubifex	*Moina*	*Artemia*	*Formulated feed*
Protein (% dry matter)	53.5±2.0	53.0±2.5[a]	56.0±3.0[b]	56.0±5.1[b]	55.0±6.0[b]
Lipid (% dry matter)	22.0±4.2	21.1±3.2[a]	24.3±2.5[b]	25.3±3.2[c]	22.5±3.0[d]
Ash (% dry matter)	12.9±1.5	13.2±2.1[a]	15.0±1.5[b]	13.1±1.5[a]	16.0±1.5[c]
Dry matter (%)	30.5±2.5	31.0±2.5	32.0±2.3	31.5±2.1	33.0±2.5

Values in a row with different superscripts differ significantly (p<0.05).

food in tanks fed *Tubifex* led to deterioration of water quality; dissolved oxygen was significantly less than other treatments. Fry fed *Tubifex* worms had poor survival, in contrast to the finding that *Tubifex* is an excellent food for catfish larvae and a potential substitute for *Artemia* (Evangelista et al., 2005). In addition, the body protein and lipid contents were lower in fry fed *Tubifex*, possibly because of the low acceptance by the fry.

The best survival was obtained in fry fed *Artemia*. Although survival was lower in fry fed the formulated diet, the use of formulated diet has an advantage when the cost of *Artemia* is taken in account. Body protein in fry fed the formulated diet did not significantly differ than in fry fed *Artemia*, suggesting that the enriched formulated diet was well accepted by the fry. The increased acceptance of the formulated diet may be attributed to the addition of dry Bombay duck fishmeal as a feed attractant.

Live food organisms must be replaced by artificial food. However, to minimize the cost of live food, the time at which feeding live food can be stopped must be investigated, along with combinations of live food and formulated diets that support growth and survival. Hence, further research is needed to study the effect of different combinations of live food and formulated diets on Asian sea bass fry.

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