Survival and Growth of Captive Reared Juvenile Seahorse (*Hippocampus kuda*) Fed Live Feeds and Fishmeal

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Abstract

Pond and aquarium keeping of seahorse (*Hippocampus kuda*) is challenging because of their feeding habits. Although seahorse is a purely active predator, we successfully raised laboratory-produced young on inert feed and evaluated the effects of readily-available cost-effective food items on their growth and survival. Two-month old laboratory bred juveniles were fed live *Artemia*, live *Mysids*, minced fishmeal, or a combination of *Artemia* and *Mysids* (1:1). Juveniles fed the combination diet reached the highest wet weight (1.93±0.31g), specific growth rate (2.21±0.07), and survival (96±3.0%), significantly ($p<0.05$) higher than juveniles fed fishmeal (1.42±0.12 g, 2.08±0.03, and 76±3.0%, respectively). Although there were insignificant differences in growth and survival between juveniles fed the combination and those fed *Mysids* or *Artemia*, the combination diet was best. This easily available feed can be used in ornamental aquaria.

Introduction

Seahorse culture has been the subject of recent attention by aquarists (Payne and Rippingale, 2000; Woods, 2000a,b) and policy planners (CITES, 2001). Concerns regarding overexploitation in the wild resulting in population declines and ever-increasing demand resulting in high market prices have led to interest in seahorse culture (Vincent, 1996; Lourie et al., 1999).

The Indian seahorse, *Hippocampus kuda*, is one of the heavily exploited seahorses along the Palk Bay coast of India (Lipton and Thangaraj, 2002). Aquaculture could reduce overexploitation by supplying the trade with bred seahorses. However, information on culturing protocols for most tropical Indo-Pacific species is limited (Do et al., 1998). Clear information on the technical feasibility of intensive

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seahorse culture is essential for reducing overexploitation of wild stocks and to improve production.

One of the main troubles in establishing seahorse aquaculture is provision of sufficient quantities of nutritionally balanced live food. In their natural environment, seahorses are voracious predators on live amphipods, copepods, mysid shrimp, and Caridian juveniles (Lovett, 1969; Tipton and Bell, 1988). In captive conditions, aquarists and researchers have tried to feed seahorses cultivable live foods such as brine shrimp, copepods, and mysid shrimps (Lockyear et al., 1997; Wilson and Vincent, 1998; Hiloman-Garcia, 1999; Payne and Rippingale, 2000). Generally, seahorses are not fed inert foods such as frozen fish fry and *Mysids* because such foods are not readily accepted by them. However, year-round mass culture of live foods is difficult and costly. Therefore, seahorse culturists have tried alternate foods such as shrimp, fishmeal based diets, raw frozen mysids, and copepods (Chen, 1990; Forteath, 2000; Woods and Valentino, 2003).

In this study, growth and survival of *H. kuda* juveniles fed one of three types of live feed or fishmeal were compared.

Materials and Methods

Experiments were conducted in the wet laboratory of the Tuticorin Research Center of the Central Marine Fisheries Research Institute in Tuticorin, India, during February 2004. Flat-bottomed circular tubs (25 l) were stocked with randomly selected 60-day-old juveniles (standard length 65.28±5.4 mm, wet weight 262.75±15.5 mg) at a density of four juveniles per 10 l. Standard length and wet weight were measured as in Lourie et al. (1999). Care was taken to choose juveniles with minimum differences in standard length, wet weight, and condition factors within replicates at the start of the experiment (ANOVA, $p>0.05$).

In-coming filtered seawater was regulated at the rate of 2 l/h. Conditioned dead corals were provided as hold fasts. A photoperiod of 12 h light:12 h dark was maintained during the 30-day experiment. Water temperature was kept at 26.0±0.85°C, dissolved oxygen at 5.20±0.24 ppm, salinity at 36±0.5 ppt, and pH at 8.00±0.26. Mean±SD water quality parameters did not vary between treatments or replicates (ANOVA, $p>0.05$). Tubs were inspected daily and excess food and excreta were siphoned out. Every five days, five individuals from each tub were randomly selected and standard length and wet weight were measured.

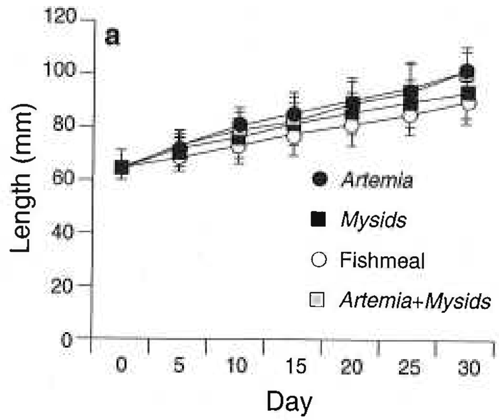
Hippocampus kuda juveniles were fed live *Artemia* (2.61±0.34 mg) collected from open salt pans in Tuticorin, live *Mysids* (2.90±0.30 mg) collected from shallow coastal seawater with a scoop net, fishmeal minced into small pieces using a sharp knife, or a combination of *Artemia+Mysids* (1:1). Juveniles were fed twice daily at 10:00 and 15:00.

Specific growth rate (SGR%) was calculated as the increase in body weight/day according to the formula ($\log_{fbw} - \log_{ibw}/t$) x 100, where fbw = final body wt in mg, ibw = initial body wt in mg, and t = number of days. The condition factor (CF) was calculated for individual juveniles as (wet wt in g/length in mm) x 100. Statistical analysis was performed by Statistica 5.0 software. Differences were considered significant when $p<0.05$.

Results

Growth and condition factor. Juveniles fed *Artemia* and *Artemia+Mysids* attained mean lengths of 101±9.45 and 100.50±8.90 mm, respectively, although the differences were not statistically different (Fig. 1). The mean length of juveniles fed *Artemia* significantly differed from those fed *Mysids* while those fed fishmeal reached the significantly lowest mean length (90.50±9.20 mm). Juveniles fed *Artemia+Mysids* attained the highest wet weight, 1.93±0.31 g, significantly higher than juveniles fed fishmeal, 1.42±0.12 g but similar to juveniles fed *Artemia* or *Mysids*. Juveniles fed fishmeal had a significantly lower SGR and condition factor than all other juveniles (Table 1).

Survival. The first mortality was observed on the fifth day of the experiment, 65 days post hatch (Fig. 2). At thirty days, juveniles fed fishmeal had a significantly lower survival than all other juveniles.



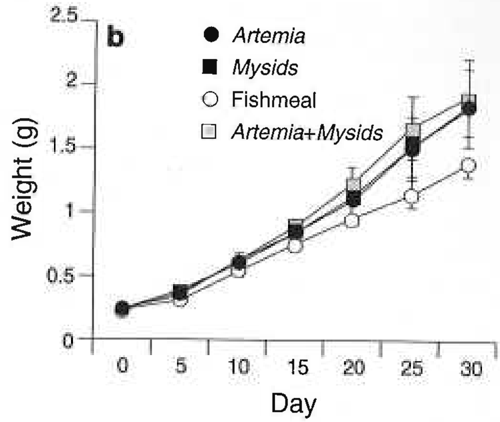


Fig. 1. Growth in (a) length and (b) weight of juvenile seahorse (*Hippocampus kuda*) fed one of four food items (means±SD, n = 3).

Table 1. Specific growth rate (SGR), condition factor, and survival of juvenile *Hippocampus kuda* fed with one of four food items (means±SD; n = 3).

Food item	*SGR (%/day)*	*Condition factor*	*Survival (%)*
Artemia	2.19±0.07[a]	1.81±0.13[a]	93.6±3[a]
Mysids	2.19±0.06[a]	1.98±0.13[a]	90.3±3.3[a]
Fishmeal	2.08±0.03[b]	1.56±0.02[b]	76.6±3.2[b]
Artemia+Mysids	2.21±0.07[a]	1.91±0.05[a]	96.7±2.9[a]

Means within a column sharing a common superscript do not significantly differ at $p > 0.5$ for SGR and $p > 0.05$ for condition factor and survival.

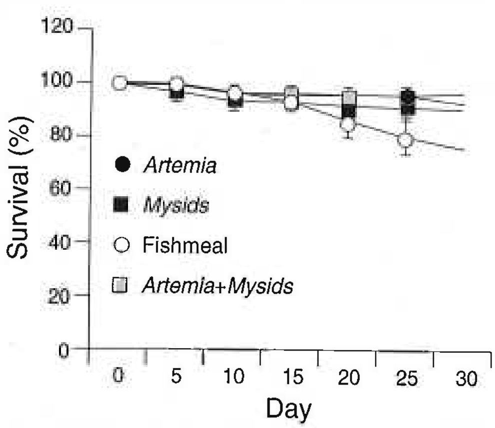


Fig. 2. Survival of juvenile seahorse (*Hippocampus kuda*) fed one of four food items (means±SD, n = 3).

Discussion

In seahorse aquaculture practices, the use of inert and frozen food can dramatically reduce costs of materials and labor. However, the appropriate food item varies depending on the growth stage (age). Two-month-old *H. kuda* juveniles can be accustomed to frozen and freshly dead foods (pers. observation). We observed that juveniles consume more motile food than non-motile.

In the present experiment, juveniles fed *Artemia* and *Artemia+Mysids* had better growth and survival than juveniles fed *Mysids* or fishmeal. The significantly higher growth and survival in groups fed *Artemia*, *Mysids*, and *Artemia+Mysids* probably reflect the importance of active live foods. Higher growth was recorded in juveniles of *Hippoglossus hippoglossus* and *H. abdominalis* fed live *Artemia* (Rosenlund et al., 1997; Woods and Valentino, 2000b). In natural conditions, seahorse juveniles feed on copepods, while adults feed on small benthic crustaceans such as amphipods (Do et al., 1998). Therefore, juveniles fed *Artemia*, *Mysids*, or *Artemia+Mysids* had a sea-based food item and relatively good growth.

Hippocampus kuda juveniles gained 28 mm in standard length when fed *Artemia* enriched with *Acetes* for 56 days (Job et al., 2002). In the present study, juveniles fed un-enriched *Artemia* gained 36 mm in only 30 days in an ambient temperature of 26.0±0.85°C. The rapid growth and higher survival of *H. kuda* in our study may be due to a more appropriate temperature in Indian laboratory conditions. Thus, temperature may play a crucial role for growth and survival of young seahorse.

Frozen *Mysid* and fish-based diets would be cheaper and more convenient dietary alternatives to collection of live feeds such as *Artemia* and *Amphipods* from the wild or their maintenance in culture conditions. However, more research is required to improve diet presentation and set up suitable rearing tanks that keep non-live foods in suspension in the water column. It is also necessary to research the nutritional profile of the feeds and the nutritional requirements of *H. kuda* at different ages.

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