Abstract

The giant fresh water prawn (*Macrobrachium rosenbergii*) industry in Sri Lanka is currently based on natural stock enhancement and capture fisheries. A feasibility study on the establishment of the giant fresh water prawn industry, through a semi-intensive pond grow-out system was initiated in Tangall/Beliatha in the Hambantota District in the Southern Province of Sri Lanka. Constraints associated with the establishment of this industry in Sri Lanka were first identified and solutions to these were tested and implemented, in order to facilitate the growth of the industry.

Two nutritionally adequate and cost effective commercial feeds using locally available ingredients were formulated and tested against a commercial marine shrimp feed, due to the unavailability of a commercial feed for pond grow-out of *M. rosenbergii* in Sri Lanka. These test feeds constituted, (Feed A- Wheat flour, meat meal, broiler finisher, fish meal, vitamin premix, cod liver oil and vitamin C, Feed B-Wheat meal, fish meal, meat meal, rice bran, maize meal, coconut oil meal, vitamin premix, cod liver oil and vitamin C) These two-feeds, although not exhibiting exceptional water stability properties compared to the commercial feed, did not significantly affect water quality parameters. Growth performance, survival rates and feed conversion efficiency were in acceptable ranges and were not significantly different with respect to all treatments ($P>0.05$). Proximate analysis of the feeds (on dry matter basis) revealed that the protein, lipids, ash and moisture contents of feeds, Feed A were respectively 30.36%, 13.83%, 18.57%, and 5.78%,, and for Feed B were 28.41, 5.89%, 19.10%, and 3.27% respectively, which were within the nutritional levels recommended for *M. rosenbergii*.. The commercial shrimp feed had protein, lipid ash and moisture contents of 36.69%, 10.58%, 12.22% and 7.89% respectively. The costs of producing Feed A and Feed B were respectively 96.84 $Rs.kg^{-1}$ and 85.18 $Rs.kg^{-1}$, while it was 150 $Rs.kg^{-1}$ for the commercial feed which is currently used for the grow-out of freshwater prawns and use of the former two feeds, where the cost is approximately

60% less are more economical to be used for *M. rosenbergii* culture, when ncompared to the latter.

Pond grow-out trials of *Macrobrachium rosenbergii* were carried out in six ponds around Tangall/Beliatha. In general all the physico-chemical and environmental parameters of ponds, favored a two cycle per year, batch grow-out system. Average temperature of ponds ranged from 29.70-31.02°C and pH values ranged from 7.28-7.46 and they were within optimum levels. Dissolved oxygen (DO) ranged from 2.25-8.21mg.L^{-1}, all of the ponds except Pond 4 (average DO was 2.25mg.L^{-1}), were within acceptable ranges. Total ammonia-nitrogen (TAN) concentrations which had an average of 0.05mg.L^{-1}was also below stressful levels. The natural productivity of ponds measured by the turbidity of water, although displayed mixed results, the majority of the ponds exhibited a high natural productivity and secchi depth ranged from11 to 63cm. Natural productivity of ponds highly depended on the management techniques adopted by the farm owners and with further training provided to them this can be rectified.

Growth rates, survival rates and pond production performance of *M. rosnebrgii* were within global standards for semi-intensive pond grow-out of *M. rosenbergii*. Survival rates ranged from a minimum of 65% observed in Pond5 to a maximum of 113% observed in Pond 1. Unrealistic survival rates observed in Ponds 1 and 2 (113% and 104%) respectively, may have been due to inaccurate counting of *M. rosenbergii* post-larvae by the Government hatchery staff from where the PLs were obtained for stocking of ponds.

Food conversion ratios (FCRs) also showed coalesce of results where majority of the ponds fell within stipulated FCRs for well managed ponds, while a few exhibited high FCRs which ranged from 1.46-4.2. The high FCRs exhibited in certain ponds may have been due to poor management strategies adopted. Pond production varied and ranged from $1287kg.ha^{-1}$-$250kg.ha^{-1}$, and majority of the ponds were within global production standards indicated by FAO (2002).

Due to the high price of feed used in this trial (marine shrimp feed) the economic gains were exiguous. It was also observed that ponds with feral fish brought in greater returns when compared to ponds with few fish. This was due to fish being sold during harvest for optimal prices and in certain occasions the income from it exceeded that from the sales of *M. rosenbergii.*

Alternative cost benefit analysis using extrapolated data of Pond 3 (pond with moderate production) and adding the cost of the alternative grow-out Feed A, displayed a profit of Rs 13,826. This cost benefit analysis took into account all production costs incurred during experimentation but did not account for investment costs as these were afforded by AIDA, Spain, an external donor.

Procurement of juveniles from the Government hatchery, which is the only one in the country, was identified as a major cost and hindrance in the development of the *M. rosenbergii* grow-out industry, throughout the country. Thus steps were undertaken to optimize hatchery protocols and develop alternate live and inert feeds to facilitate cost reduction and maximize the out-puts of *M. rosenbergii* post-larvae in Sri Lanka.

Two brands of *Artemia*; Red Top *Artemia,* currently used for juvenile production of *M. rosenbergii* in Sri Lanka and is imported from USA and, Hambantota *Artemia,* a locally produced *Artemia* were tested against *Moina Micruca* for larval rearing of *M. rosenbergii*. Proximate analysis of nutritional contents of the three live feeds, Hambantota *Artemia*, Red Top *Artemia* and *Moina* displayed; Protein: 46.66%, 50.94%, 64.62% and Lipids: 16.82, 14.01, 27.48 respectively. *Moina* was found to be the most nutritious of the three live feeds in terms of protein and lipid concentrations. But due to its large average size, 0.805mm, compared to the Hambantota *Artemia* and Red Top *Artemia,* 0.455mm and 0.512mm respectively and low tolerance to salinity, LCT 100 and LCT 50 for $15g.kg^{-1}$ which were approximately 38.38mins and 13.38 mins respectively, proved to be unsatisfactory for larval rearing of *M. rosenbergii* as compared to the two *Artemia* feeds.

Hambantota *Artemia* was also found to have greater hatching rates when compared to Red Top *Artemia,* 82% and 76% respectively. Also the average size of Hambantota *Artemia* was found to be significantly smaller compared to that of Red Top *Artemia,* 0.455mm and 0.512mm respectively. The price of Hambantota *Artemia* was also less than that of the Red Top *Artemia,* 5.60 $Rs.g^{-1}$ and $9.25Rs.g^{-1}$, although this price difference did not make a significant difference in the final production costs of *M. rosenbergii* post-larva fed with these two types of *Artemia*. The Hambantota *Artemia* and Red Top *Artemia* feeds performed equally well in terms of survival rates and production rates, which were respectively 3.33%, 52.66% and $27.66PL.L^{-1}$, $26.33PL.L^{-1}$, which indicates that either type of *Artemia* could be recommended for the use in *M. rosenbergii* juvenile production in Sri Lanka.

Due to the slightly higher nutritional value and improved hatching rates of Hambantota *Artemia* when compared to Red Top *Artemia* during the present study, the advantage of using the former is evident, which is locally produced for larval rearing of *M. rosenbergii*. It is also recommended to promote the establishment of an export market for this local *Artemia* and to develop the "*Artemia*" industry within the coastal belt of Sri Lanka, which would in turn help provide employment opportunities and attract foreign exchange to the country.

Two fresh inert feeds were formulated from locally available ingredients and tested against three currently employed commercial feeds from hatcheries from Fiji Islands and India. The two locally formulated feeds (Ruhuna Feed A and B) and commercially used Feed C were found to exhibit optimal production rates and larval conditioning of *M. rosenbergii.* The nutritional requirements of inert feeds for larval rearing of *M. rosenbergii* observed during the current trials was an optimum protein content of between 48-58% and lipid content of approximately 49%. The production costs revealed that either Ruhuna Feeds A and B or Commercial Feed C are suitable for *M. rosenbergii* larval rearing in Sri Lanka.

Hatchery optimization for larval rearing of *M. rosenbergii* included trials on the use of an "Improved Static Green Water (ISGW)" system and comparing results with the currently employed "Clear Water (CW)" system in Sri Lanka. This indicated that the former was the most efficient and cost effective for *M. rosenbergii* juvenile production in Sri Lanka. Survival rates for ISGW system and CW system were 52.66% and 29.00% respectively, and the former was significantly higher. The production costs for ISGW system and CW system were 1.98Rs.PL^{-1} and 3.83Rs.PL^{-1} respectively, which indicated obvious benefits from the former for the development of the *M. rosenbergii* industry in Sri Lanka. The fact that the ISGW system employs less complicated technology when compared to the CW system, also indicates an easy technology transfer and implementation of the former for local back yard hatcheries and for concurrent improvement of supply of *M. rosenbergii* juveniles in Sri Lanka.

Studies on optimum salinity for larval rearing of *M. rosenbergii* indicated that larval rearing is not viable at salinities below 6g.kg^{-1} and it could be efficiently conducted in salinities ranging from 6-12g.kg^{-1} without a significant effect on survival and production rates of *M. rosenbergii* juveniles. Salinities between 4-6g.kg^{-1} resulted in 100% mortality of *M. rosenbergii* larvae by the 3rd day of the cycle. *M. rosenbergii* larvae also exhibited optimal conditioning at salinities greater than 8g.kg^{-1}, although the production rates were not affected at a lower salinity of 6g.kg^{-1}