Evaluation of growth and breeding performances of *Pethia reval* (red fin barb), with different feeds under aquarium condition

RMLW Rathnayake¹, RRAR Shirantha², GRH Rupika², HMP Kithsiri², WAD Nayananjalie¹

¹Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka
²National Aquatic Resources Research and Development Agency, Crow Island, Colombo, Sri Lanka

**Abstract**- Endemic fish species contribute 4% of the total freshwater ornamental fish exports in Sri Lanka. Most of them are collected from their natural habitats, wild population are depleting. *Pethia reval* is a newly described highly threatened, fish species endemic to Sri Lanka. This study was carried out to determine the best feed type out of *Moina* (*T*₁), Ox – heart (*T*₂) and Pellet feed (*T*₃), to optimize the growth and reproductive performances of *P. reval*. Brooders *P. reval* were (total body length ranged from 20 to 25 mm) collected from Aththanagalu Oya, and stocked in cement tanks (5’x 3’x 3’) at NARA. Feed consumption, total body length and body weight of all brooders were recorded monthly. Acceptability of feeds was determined by visual observations. Water quality parameters were measured biweekly. After four months, brooders fish were stocked in glass tanks (2’x 1’x 1’) to evaluate their breeding performances. The number of laid and fertilized eggs and survivals were recorded at 1st spawning. Specific growth rates (SGR), feed conversion efficiency (FCE), fertilization rate of eggs and survival rate of fry were then calculated. Complete Randomized Design (CRD) was used and data were analyzed by SAS computer software subsequently means were compared using Duncan’s New Multiple Range test. Specific growth rate was not significantly different (*P > 0.05*) among the treatments whereas FCE was significantly different (*P < 0.05*) in *T*₁. The fertilization rate was significantly higher (*P < 0.05*) in fish, those fed with *T*₁ and *T*₃ than that of *T*₂. Significantly higher (*P < 0.05*) survival rate was observed in *T*₂ than *T*₁ and *T*₃. Visual observations proved that *T*₂ was the most preferable feed compare to the other tested feed types. The present study showed that under aquarium condition the better growth and reproductive performances of *P. reval* can be obtained with *Moina*.

**Index Terms**- *Pethia reval*, *Moina*, Ox heart, Pellet feed, Growth and reproduction

I. INTRODUCTION

The ornamental fish industry is one among the most valuable foreign exchange earners in Sri Lanka [1]. *Pethia reval*, has a significant demand in the international market, is an endemic freshwater species in Sri Lanka [2]. The wild populations of many endemic ornamental fish species are reported to be declined, and some have already become endangered due to several anthropogenic activities viz., overexploitation, aquatic pollution, habitat modification and degradation, river damming and, etc. The scenario is severe for the fish species like *P. reval*, which is mainly collected from the wild for export, thereby wild population decline is continued. At present *P. reval* is an endangered fish species in Sri Lanka MOE [3]. Since wild collection has been identified as one factor that attributes for population decline in endemic ornamental fishes of the country, the government has already imposed several rules and regulation in order to protect them in situ.

However, there still is a great demand for *P. reval* compare to other aquarium fish species. Therefore, development of an improved captive breeding technique for the endemic fish species would be a good strategy to reduce the exploitation pressure on the wild populations and to increase their export. As such the study of growth and breeding performance of *P. reval* in captive condition is a timely requirement, which would enhance the export oriented ornamental fish industry in Sri Lanka.

Feeding of fish has become one of the critical management practices of today as it occupies 60 - 70% from the total cost of production [4]. Growth and breeding performance of fish is highly depending on the feed type that consumed by fish [5]. Feeding of the most appropriate feed minimizes the feed cost as well as cost of production [6]. Hence, determination of the most suitable feed type is very important for feeding of *P. reval* in captive conditions.

Therefore, present study was carried out to determine the best feed type of three selected fish feeds; pellet feed, live feed (*Moina*) and ox-heart, which can maximize the growth and breeding performance of *P. reval* under given optimum environmental conditions.

II. MATERIALS AND METHODS

**Experimental fish and feed preparation**

*P. reval* with total body length of 20 – 25 mm were collected from Aththanagalu Oya at Kelani river basin, Sri Lanka. They were acclimatized in nine indoor glass tanks (15 fish per tank) for three days and fed with *Moina* at the National Aquatic Resources Research and Development Agency (NARA), Crow Island, Mattakkuliya, Colombo. For the experimental feeding, they were fed under three treatments viz. *Moina*; a live feed, ox-heart; a formulated feed by NARA and pellet feed. *Moina* was cultured in cemented tanks available at NARA and collected by organza net. Dried ox-heart was processed by boiling for 15 minutes. After that, boiled ox-heart was dried in an oven at a temperature of 50°C for a period of 12 hours. Then, it was grinded to a particle size of 0.25 - 1.00 mm and mixed with

www.ijsrp.org
antibiotics, vitamin E and vermicides. Prepared feed was kept in a refrigerator. Commercially available pellet feed was used as the control.

**Determination of nutrient contents in feeds**

Feed samples (Moina and ox-heart) were randomly collected, dried, ground and stored in plastic bottles until further analysis. The proximate composition of the experimental diets were determined according to the procedures of the Association of Official Analytical Chemists [7]. Gross energy content of feeds was determined using a Ballistic bomb calorimeter. Proximate composition of the commercial feed as given by the feed manufacturer was presented in Table 1.

**Feeding trial**

After the acclimation period, 135 fry of P. reval (average weight 220 ± 40 mg; average length 22.8 ± 0.6 mm) were randomly stocked in nine outdoor, cemented tanks (1.524 x 0.914 m²), where water level of the tanks was maintained at 15 cm with 15 fry per tank following a completely randomized design. Each test feed was randomly assigned to three tanks (as replicates) and given two times per day viz. at 9.00 am and 4.00 pm during the experimental period. Twenty grams of ox-heart and pellet feed were given to fish in a replicate at each feeding time. Fifty milliliters of Moina was given at one feeding time for each replicate in which Moina used as a treatment feed. The weights of Moina in 50 mL were measured. Feeding trial was continued for four months. All the tanks were provided with continuous aeration during the entire experimental period. The uneaten feed and faecal matter were siphoned out.

**Breeding trial**

After three months of feeding trials, randomly selected mature fish were used for breeding trial. Breeding trial was done in indoor glass tanks (60 x 30 cm) where water level was maintained at 10 cm and coir was used as egg layering substrate. Mature males and females were caught from rearing tanks and acclimatized in 2:1 sex ratio at a stocking density of 6 individual per tank. Male fish were introduced to the breeding tank in the morning and female fish were introduced in the evening. After two days later, both female and male adult fish were removed from the breeding tanks.

Fry produced after hatching of eggs, were reared for 21 days in indoor glass tanks. They were fed only with boiled egg yolk. Egg yolk was dissolved in distilled water and then filtered solution was fed in equal amounts by using a syringe.

**Water quality measurements**

Water quality parameters were maintained similar to their natural habitat in the aquarium. Water temperature and pH were maintained around 27°C and 6.5 - 7.5 respectively. Water samples were collected from each replicate around 8.00 - 9.00 am to measure the physico-chemical parameters of the rearing water viz. temperature, dissolved oxygen, pH, nitrites and ammonia biweekly. Water temperature, pH and dissolved oxygen were measured using thermometer, digital pH meter and digital dissolve oxygen meter, respectively. Alkalinity of water was measured by digital titrator, titrate with H₂SO₄ and Brom cresol green was used as indicator. NO₃⁻, PO₄³⁻ and NH₃ contents were measured using HACH programme; 2530, 3025 and 2400 respectively.

**Data collection**

The palatability, acceptance and stability of feeds in water were determined by visual observations which were categorized as high, moderate and low. During the experiment (at the beginning and monthly), live body weight and total body length of the fish were recorded and feed conversion efficiency (FCE) and specific growth rate were calculated using the following standard formulae (01, 02, 03):

\[ FCE (\%) = \frac{\text{Total weight gain}}{\text{Total amount of feed consumed}} \times 100 \]  
\[ \text{Specific growth} (w) = \frac{[\ln(\text{mean final total weight}) - \ln(\text{mean initial total weight})]}{\text{Number of days}} \]  
\[ \text{Specific growth} (l) = \frac{[\ln(\text{mean final total length}) - \ln(\text{mean initial total length})]}{\text{Number of days}} \]

The total numbers of laid eggs were counted by microscopic eye piece. After two days of egg laying, the total numbers of fry produced after hatching and at 21st day, number of survivals were counted. Mean numbers of eggs laid by one female, mean number of fry produced and mean survivals were calculated in each replicate. Fertilization and survival rates were calculated using the following formulae (04, 05):

\[ \text{Fertilization rate} = \frac{\text{Number of eggs hatched}}{\text{Number of eggs laid}} \times 100 \]  
\[ \text{Survival rate of fry} (\%) = \frac{\text{Number of fry survived after one month}}{\text{Number of fry survived at the beginning}} \times 100 \]

The difference among the treatments were assessed using one-way analysis of variance (ANOVA) procedure in Statistical Software for Data Analysis ver 9.0 [8]. Tukey’s Studentized
Range Test (TSRT) was used to determine the significant difference at 5% (P < 0.05) level.

III. RESULTS AND DISCUSSION

Nutrient composition of experimental feeds

Table 01: Nutrient composition of experimental feeds

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Moina</th>
<th>Ox-heart</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein (%)</td>
<td>58.43</td>
<td>60.84</td>
<td>42.00</td>
</tr>
<tr>
<td>Crude Fibre (%)</td>
<td>10.22</td>
<td>3.05</td>
<td>4.00</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>5.43</td>
<td>14.46</td>
<td>10.00</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>8.47</td>
<td>11.56</td>
<td>12.00</td>
</tr>
<tr>
<td>Gross energy (kcal/kg)</td>
<td>2657</td>
<td>3543</td>
<td>3350</td>
</tr>
</tbody>
</table>

According to the Table 1, the highest crude protein content was recorded in ox-heart when, comparing with other two treatment feeds. Crude protein requirement of juvenile fish varies from 30 – 55% in their diets NRC [9]. Further, Mohanta, Mohanty [10] reported that better growth performances can be achieved when P. gonionotus fingerlings fed with 31.8% of crude protein. Hence, the amount of crude protein levels available in the feeds may be higher than the required levels for P. reval. Crude fat and energy contents were also higher in ox-heart feed with compared to Moina and commercial feed. The highest crude fibre and ash content were observed in Moina and commercial feed, respectively.

Quality of the feeds

Table 02: Quality of the feeds according to visual observations

<table>
<thead>
<tr>
<th>Experimental feeds</th>
<th>Moina</th>
<th>Ox-heart</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Palatability</td>
<td>High</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Stability</td>
<td></td>
<td></td>
<td>High</td>
</tr>
</tbody>
</table>

Quality of experimental feeds was determined by means of acceptance, palatability and stability of feeds (Table 2).

Ox-heart was the most accepted feed for P. reval and followed by Moina based on visual observations. However, commercial feed was ranked as the least accepted feed. According to visual observations, palatability of ox-heart and Moina were higher with compared to commercial feed. This may due to the nature of feed type; because, soft feeds often proves to be more palatable to the fish [11]. Since Moina was a live feed, the stability was not determined. Even though, fat content in feed is known to give the compactness for the feed by preventing the entry of water, higher stability was shown by commercial feed in water than ox-heart.

Growth performances

Table 03: Growth and breeding performances of fish fed with different feeds (mean+SE)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Moina</th>
<th>Treatment diets</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet body weight, mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 month</td>
<td>310a</td>
<td>240b</td>
<td>250b</td>
</tr>
<tr>
<td>2 months</td>
<td>430a</td>
<td>360b</td>
<td>350b</td>
</tr>
<tr>
<td>3 months</td>
<td>580</td>
<td>600</td>
<td>570</td>
</tr>
<tr>
<td>4 months</td>
<td>1280b</td>
<td>1350a</td>
<td>1330a</td>
</tr>
<tr>
<td>Total body length, mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 month</td>
<td>27.4b</td>
<td>25.3a</td>
<td>25.8a</td>
</tr>
<tr>
<td>2 months</td>
<td>31.3b</td>
<td>29.2a</td>
<td>29.4a</td>
</tr>
<tr>
<td>3 months</td>
<td>35.0</td>
<td>35.0</td>
<td>34.8</td>
</tr>
<tr>
<td>4 months</td>
<td>43.1a</td>
<td>44.0b</td>
<td>43.2a</td>
</tr>
</tbody>
</table>
P. reval fed with Moina achieved significantly higher (P < 0.05) body weight and length compared to other two treatment feeds at the end of 2nd month. However, wet body weight and body length of fish were similar (P > 0.05) at the end of 3rd month. At 4 months of age, fish fed with ox-heart and commercial feeds gained higher weight compared to fish fed with Moina. Further, at the end of 4th month, body length was significantly higher (P > 0.05) in fish fed with ox-heart compared to fish fed with Moina and commercial feed. Sundarabarathy, Edirisinge [12] reported that mature body weight and length of P. titteya are 1240 ± 470 g and 47 ± 6.1 mm, respectively. Therefore, our observations are also in accordance with that considering Puntius spp.

Specific growth rate corresponding to weight and length were similar (P > 0.05) among P. reval fed with three experimental feeds.

There was a significant difference (P < 0.05) in FCE in fish fed with different feeds (Table 3). The highest FCE was observed in the fish fed with Moina whereas the lowest was observed with the fish fed with ox-heart. Previous studies done with Gold fish and Heterocliarias also observed better performances [13, 14].

Breeding performances

Significantly higher (P < 0.05) number of eggs laid by fish were reported in fishes fed with Moina and ox-heart with compared to the fish fed with commercial feed. However, significantly higher (P < 0.05) fertility and survival rates were observed in P. reval fed with Moina and commercial feed compared to fish fed with ox-heart. In average, it seems that P. reval performed well with feeding of any tested feeds under captive breeding. Sundarabarathy, Edirisinge [12] also observed that, under captive breeding, P. titteya performed well with feeding different feeds.

Water quality parameters

Throughout the experiment, water temperature of rearing tanks were only ranged around 27.0 °C and there was no significant difference (P > 0.05) in water temperature of tanks allotted with three treatment feeds. According to Boyd [15], that was the optimal level for the growth of tropical fresh water fish species.

Acceptable limit of pH for the fresh water fish was 6.5 – 9.0 [16] and pH of the experiment tanks was within the favorable range throughout the study. pH level of water ranged somewhat higher which allocated the ox-heart feed than other treatments. However, there was no significant difference (P > 0.05) between pH values in water among three treatment feeds. The results indicated that, pH of water increased with the increase of protein content in feeds and it agreed with the finding of Kalla, Bhatnagar [17]. Feeds with high protein release higher amount of ammonia than the feeds with lower protein and causes increase in pH due to formation of NH₄⁺ complex in water [16]. Dissolved oxygen levels ranged from 5.27 – 6.11 mg/L with the treatment feeds. This range was higher than the lethal level of 3.0 mg/L [16]. The lowest DO level in rearing tanks allocated with ox-heart and it was the feed that contain highest crude protein. However, there was a significant difference (P < 0.05) in DO level of water in rearing tanks allocated with three treatments it showed that DO of pond water decreased with increased protein content of feeds. According to Kalla, Bhatnagar [17] the feeds with highest protein content have lower DO value than the feeds with lower protein content.

According to Boyd (1982), the favorable total NH₃ level was 0.6 – 2.0 mg/L and NH₄ level of present study varied within the range. Further, there was no significant difference (P > 0.05) in total NH₃ content in rearing tanks allocated with different treatments. However, total NH₃ concentration of water, allocated with ox-heart was higher than other treatments. our findings were accordance with the already reported values of Kalla, Bhatnagar [17], which revealed that, feeds with high protein content increase the NH₃ concentration in water.

According to [16], the favorable hardness level for achieving optimum growth and reproduction of ornamental fish was 100 - 300 mg/L and the hardness levels in water allocated with each treatment were ranged within the favorable limit. The highest mean hardness was recorded in rearing tank allocated with ox-heart and however, there was no significant difference (P > 0.05) in hardness level of water in rearing tanks among the treatments during the experimental period (Table 4).

### Table 04: Variation of total NH₃ concentration and water hardness in rearing tanks allocated with different feeds

<table>
<thead>
<tr>
<th>Water parameter</th>
<th>Treatment feeds</th>
<th>Moina</th>
<th>Ox-heart</th>
<th>Commercial</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

www.ijsrp.org
IV. CONCLUSIONS

*Moina* is the most suitable feed type among experimental feeds for *P. reval* to maximize the growth performances especially at young stages. Considerable FCE and fertility can be achieved by feeding *Moina* to *P. reval* under the aquarium condition. Feeding *Moina* does not change the water quality parameters under the aquarium conditions.

### REFERENCES


[12] Sundarabarathy TV, Edirisinghe U, Dematawewa CMB. Captive Breeding and Rearing of Fry and Juveniles of Cherry Barb (*Puntius titteya*


### AUTHORS

**First author** – RMLW Rathnayake, B.Sc., Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura (50000), Sri Lanka. Email: <laksirathnayake@yahoo.com>

**Second author** - RRAR Shirantha, M.Phil, National Aquatic Resources Research and Development Agency, Crow Island, Colombo, Sri Lanka. Email: <ramanishirantha@gmail.com>

**Third author** - GRH Rupika, M.Sc, National Aquatic Resources Research and Development Agency, Crow Island, Colombo, Sri Lanka. Email: <skyhemlk@yahoo.com>

**Fourth author** - HMP Kithsiri, PhD, National Aquatic Resources Research and Development Agency, Crow Island, Colombo, Sri Lanka. Email: <palihikkaduwa@gmail.com>

**Fifth author** - WAD Nayananjalie, PhD, Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura (50000), Sri Lanka. Email: <nayananjalie@yahoo.com>

**Corresponding author** - WAD Nayananjalie, Email: <nayananjalie@yahoo.com>, Tel: +94 (0) 71 4458671