

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

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**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<sub>1</sub>), Ox – heart (T<sub>2</sub>) and Pellet feed (T<sub>3</sub>), 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 1<sup>st</sup> 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<sub>1</sub>. The fertilization rate was significantly higher ( $P < 0.05$ ) in fish, those fed with T<sub>1</sub> and T<sub>3</sub> than that of T<sub>2</sub>. Significantly higher ( $P < 0.05$ ) survival rate was observed in T<sub>3</sub> than T<sub>1</sub> and T<sub>2</sub>. Visual observations proved that T<sub>2</sub> 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 [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<sup>o</sup>C for a period of 12 hours. Then, it was grinded to a particle size of 0.25 - 1.00 mm and mixed with

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 m<sup>2</sup>), 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 trail 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 trail**

After three months of feeding trails, randomly selected mature fish were used for breeding trail. Breeding trail 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 syringer.

**Water quality measurements**

Water quality parameters were maintained similar to their natural habitat in the aquarium. Water temperature and pH were maintained around 27C<sup>0</sup> 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 H<sub>2</sub>SO<sub>4</sub> and Bromcresol green was used as indicator. NO<sub>3</sub><sup>-</sup>, PO<sub>4</sub><sup>-3</sup> and NH<sub>3</sub> 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):

$$FCE (\%) = \frac{Total\ weight\ gain}{Total\ amount\ of\ feed\ consumed} \times 100 \dots\dots\dots (01)$$

$$Specific\ growth\ (w) = \frac{[\ln(mean\ final\ total\ weight) - \ln(mean\ initial\ total\ weight)]}{Number\ of\ days} \dots\dots\dots (02)$$

$$Specific\ growth\ (l) = \frac{[\ln(mean\ final\ total\ length) - \ln(mean\ initial\ total\ length)]}{Number\ of\ days} \dots\dots\dots (03)$$

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 21<sup>st</sup> 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):

$$Fertilization\ rate = \frac{Number\ of\ eggs\ hatched}{Number\ of\ eggs\ laid} \times 100 \dots\dots\dots (04)$$

$$Survival\ rate\ of\ fry\ (\%) = \frac{Number\ of\ fry\ survived\ after\ one\ month}{Number\ of\ fry\ survived\ at\ the\ beginning} \times 100 \dots\dots (05)$$

**Data analysis**

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**

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

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**

Experimental feeds	Observations		
	Acceptance	Palatability	Stability
<i>Moina</i>	High	High	-
Ox-heart	High	High	Moderate
Commercial	Low	Moderate	High

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 $\pm$ SE)**

Parameters	Treatment diets			SE
	<i>Moina</i>	Ox-heart	Commercial	
<b>Wet body weight, mg</b>				
1 month	310 <sup>a</sup>	240 <sup>b</sup>	250 <sup>b</sup>	30
2 months	430 <sup>a</sup>	360 <sup>b</sup>	350 <sup>b</sup>	30
3 months	580	600	570	50
4 months	1280 <sup>b</sup>	1350 <sup>a</sup>	1330 <sup>a</sup>	80
<b>Total body length, mm</b>				
1 month	27.4 <sup>b</sup>	25.3 <sup>a</sup>	25.8 <sup>a</sup>	0.1
2 months	31.3 <sup>b</sup>	29.2 <sup>a</sup>	29.4 <sup>a</sup>	0.8
3 months	35.0	35.0	34.8	1.6
4 months	43.1 <sup>a</sup>	44.0 <sup>b</sup>	43.2 <sup>a</sup>	1.4

<b>SGR (w)</b>	1.34 x 10 <sup>-2</sup>	1.48 x 10 <sup>-2</sup>	1.49 x 10 <sup>-2</sup>	3.2 x 10 <sup>-6</sup>
<b>SGR (l)</b>	5.6 x 10 <sup>-3</sup>	5.5 x 10 <sup>-3</sup>	5.0 x 10 <sup>-3</sup>	5.7 x 10 <sup>-7</sup>
<b>FCE</b>	1.35 x 10 <sup>-2a</sup>	8.2 x 10 <sup>-3b</sup>	1.07 x 10 <sup>-2c</sup>	2.2 x 10 <sup>-5</sup>
<b>Mean total number of eggs/female</b>	54 <sup>a</sup>	57 <sup>a</sup>	42 <sup>b</sup>	14
<b>Fertility rate (%)</b>	88 <sup>a</sup>	84 <sup>b</sup>	90 <sup>a</sup>	10
<b>Survival rate of fry (%)</b>	85 <sup>a</sup>	78 <sup>b</sup>	93 <sup>a</sup>	11

<sup>a,b</sup>: values with different superscripts within row were significantly different (P<0.05)

*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 2<sup>nd</sup> month. However, wet body weight and body length of fish were similar (P > 0.05) at the end of the 3<sup>rd</sup> 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 4<sup>th</sup> month, body length was significantly higher (P > 0.05) in fish fed with ox-heart compared to fish fed with *Moina* and commercial feed. [Sundarabharathy, Edirisinghe \[12\]](#) 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 *Heteroclinus* 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. [Sundarabharathy, Edirisinghe \[12\]](#) 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 NH<sub>4</sub><sup>+</sup> 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 NH<sub>3</sub> level was 0.6 – 2.0 mg/L and NH<sub>3</sub> level of present study varied within the range. Further, there was no significant difference (P > 0.05) in total NH<sub>3</sub> content in rearing tanks allocated with different treatments. However, total NH<sub>3</sub> 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 NH<sub>3</sub> 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 with in 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 NH<sub>3</sub> concentration and water hardness in rearing tanks allocated with different feeds**

Water quality parameter	Treatment feeds			
	<i>Moina</i>	Ox-heart	Commercial	SE

Temperature (°C)	27.01	27.00	27.01	0.1
pH	6.92	7.10	7.00	0.05
DO (mg/L)	6.11	5.27	6.31	0.36
Total Ammonia (mg/L)	0.90	1.18	0.97	0.03
Hardness (mg/L)	120.92	126.35	124.68	2.5

#### 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.

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