

RESEARCH ARTICLE

Effect of different commercial feeds on growth and reproductive performance of Guppy, *Poecilia reticulata* Peters

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Abstract: A 15 week feeding trial was conducted to investigate the effects of three commercial feeds; Prima diet, Galaxy diet and Prawn diet on the growth performance and reproductive performance of Guppy, *Poecilia reticulata*. Triplicate groups of guppy juveniles (mean initial weight of 0.07 + 0.03g) were stocked in 9 indoor glass aquaria (30 x 22 x 8.5cm), at a density of 20 fish tank⁻¹ at a sex ratio of 1:1. Fish were fed ad-libitum 5 times daily using respective diet and growth performance (Total length, weight, %SGR, FCR) and reproductive performance (Gonadosomatic index (GSI), Time taken for first spawning, total number of larvae, and spawning interval) were evaluated. Feed consumption (10.80-12.58 % Bwt/day) was not differed among treatments. The highest growth performance of fish in terms of final mean body weight (0.83+ 0.46g), total length (4.63 + 0.41cm), and specific growth rate (SGR 2.34 + 0.03) was observed in the fish fed Prawn diet compared to fish fed on other two feeds. Total body weight and GSI were found to be significantly higher in females compared to males in all treatments. Fish fed on Prawn diet recorded the significantly highest mean number of larvae per tank (33.67 + 7.51). However, total length of larvae showed no significant difference among three treatments. In the present study significant highest growth and reproductive performance (in terms of number of larvae tank⁻¹) of guppy was observed in fish fed on Prawn diet. Therefore, for guppy broodstock rearing in indoor aquaria Prawn diet could be recommended as the best feed out of three commercial diets tested herein.

Keywords: Guppy, *Poecilia reticulata*, commercial diets, growth, reproduction

Introduction

Ornamental fish industry is a fast developing industry in Sri Lanka and the foreign exchange earnings has been increased from Rs.30 million in 1981 to Rs.2288 million in 2017 as a result of increasing exports of aquarium fish (Wijesekara and Yakupitiyage, 2001, Fisheries Statistics, 2018). Of the freshwater fish species exported from Sri Lanka, guppy varieties have received the highest rank (60-70%) and several new guppy varieties produced by Sri Lankan aquaculturists have won awards in international exhibitions (MFARD 2015). Moreover, many small-scale commercial aquaria provide fish to the local market and guppy is one of the highest marketable ornamental fish in the local market. Being a coloured

and a hardy fish, guppy varieties are very popular among fish hobbyists.

Good nutrition in aquaculture is essential to produce a healthy, high quality product (Shim, 1989) and nutrition is critical because feed represents 50-80% of the production costs (FAO, 2017). Fish nutrition research has advanced dramatically in the recent years with the development of nutritionally balanced commercial diets that promote optimal fish growth and health (Giri et al, 2017). Although variety of commercial feeds is available in the market their cost effectiveness and suitability for different types of ornamental fish is not very clear. Very little information is published on the nutritional requirements and the effect of different commercial feeds on cultured ornamental fish in Sri Lanka. Ornamental fish farmers in Sri Lanka use most

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economical feed in their aquaria (unpublished data) without considering the nutritional values of the diet. The three commercial feeds; Prima diet, Galaxy diet and Prawn diet, are commonly used fish feeds in aquaria in Sri Lanka for rearing guppy juveniles and broodstock (personal observations). Therefore, present study was undertaken to investigate the suitability of three commercial feeds and their effects on the growth and reproductive performance of guppy, *Poecilia reticulata*.

Materials and methods

P. reticulata juveniles reared in the indoor aquarium of Department of Fisheries Biology, University of Ruhuna were used in this study. Three commercial feeds, Prima diet (Rs 130 kg⁻¹), Galaxy diet (Rs 450 kg⁻¹) and Prawn diet (Rs 160 kg⁻¹) available in the market were selected as experimental feeds. Nine glass tanks (30x 22x 8.5 cm) in the indoor aquarium were filled with dechlorinated tap water and aerated continuously. Juvenile *P. reticulata* (0.07 ± 0.03g) were externally sexed, using the gravid spot on the abdomen of females and 90 males and 90 females were randomly stocked in the tanks at a stocking density of 20 fish / tank at a sex ratio of 1:1. Initial mean total length and mean weight of fish were 2.01 ± 0.25 cm and 0.07 ± 0.03 g respectively.

The diets were analyzed for crude protein by Kjeldhal method, for lipid by Soxhlet extraction, for ash by incineration at 500 °C in a muffle furnace for 3.5 hours and moisture by drying at 105°C to constant weight (De Silva and Radampola, 1990).

Feeding practices and measurements taken:

Prima diet was a powdered feed and Galaxy diet and Prawn diet consisted of comparatively large pellets. Therefore, Galaxy diet and Prawn diet were crushed into small crumbles as the pellet size was too large for the juveniles. Fish were fed *ad-libitum*, 5 times daily at two-hourly intervals from 8.00 a.m. to 4.00 p.m. for 15 weeks and daily food consumption was recorded. All experimental tanks were closely observed prior to feeding for appearance of fry and to determine the number of females that have commenced spawning. The spawnings and number of fry were recorded in each tank. False bottoms were introduced to aquaria in order to make it easier to separate and collect the fry when mature gravid females commence spawning, because Guppy females are cannibalistic on their fry. Tanks were cleaned everyday by siphoning faeces and wastes, and water was completely changed at 3 weekly intervals.

Total length (cm) and body weight (g) of all fish were recorded individually at 3 week intervals. At the end of the experimental period, length and weight were measured and 10 fish from each tank (5 females and 5 males) were sacrificed, liver and gonads weights were taken to determine the hepatosomatic and gonadosomatic indices. Increase in total length and weight, % Specific Growth Rate in weight (%SGR), food consumption (%body weight day⁻¹) and Food Conversion Ratio (FCR) were calculated (De Silva and Radampola, 1990). Time to first spawning in days (in each tank), spawning interval (interval in days between spawnings), total number of spawnings per tank and total number of larvae per tank were used to compare the reproductive performance of guppy fish fed on different feeds.

Statistical analyses

Randomized Block ANOVA was carried out to test the effects of different commercial feeds on the total length and body weight of Guppy. One-way ANOVA was carried out to test the effects of feeds on %SGR, FCR and reproductive performance of Guppy. Data were expressed as a mean ± SD. Significant ($p < 0.05$) differences between means were tested using Duncan's multiple range test.

Results

Proximate analysis of feeds indicated that the Prima diet and Prawn diet had higher protein content (43.9% and 42.8% respectively) and Galaxy diet had low protein content (32.8%). The highest lipid content of 12.2% was recorded in Prima diet and Prawn diet had low lipid contents (6.4%) (Table 1). All fish fed aggressively whenever the feed was introduced in to aquaria throughout the experimental period. Daily food consumption (as % of BWt day⁻¹) ranged from 10.80% in Prawn diet to 12.58% in Prima diet and was not significantly different among fish fed on three experimental feeds (Table 2). Food consumption (as % BWt day⁻¹) showed a decreasing tendency with time.

Significant differences in mean final body weight, total length and %SGR were observed among the three treatments (Table 2). Total length, body weight and %SGR were significantly higher in fish fed on Prawn diet compared to fish fed with other two feeds. In all three treatments body weight was significantly higher ($P < 0.05$) in females compared to males (Table 2, Figure 1). However, no significant difference in FCR (0.72 - 1.08) was observed in three groups of fish received different treatments. During the experimental period no mortality was recorded in any treatment (Table 2). Although average HSI of males was

significantly higher in fish fed on Prawn diet, HSI of females was not different among three treatments (Table 3). Average GSI values of females are higher than in males in all three treatments (Table 3). GSI ranged from 0.03-0.14g for males and 0.18-0.26g for females (mention SD values).

Fish started to spawn in 8th week (Table 4). Spawning interval was determined as the mean interval in days between spawnings. No significant differences were observed between mean interval of spawnings (ranged from 1 to 14 days) and mean number of spawnings per tank (from 1 - 9) in different treatments. Although mean number of larvae per spawning were 2.4, 4.9 and 4.1 for Prima, Galaxy and Prawn diets respectively, the differences were not significant (Table 4). The mean total number of larvae per tank (33.6 ± 7.51) was significantly higher in fish fed on Prawn diets. The mean larval length was not significantly different between any of the three diets.

Discussion

Guppies are usually known as hardy fish, because they have an ability to tolerate a wide range of biotic and abiotic conditions (Fernando and Phang, 1994). No mortality was recorded throughout the experimental period in the present study. Mean food consumption was around 10-12% of body weight among fish fed with three feeds and was not significantly different among treatments. Initially, daily food consumption (% body weight day⁻¹) was higher and decreased with time for all diets. At the beginning of the experiment, it was difficult to identify the amount of diet needed to feed the fish to satiation and therefore, during the first few days fish may have been overfed. Food intake is high at the start of the growing period and lower towards the time when animals getting large. This trend is a common phenomenon and it has been observed in many species (De Silva and Perera, 1985).

Fish fed on Prawn diet showed significantly highest growth in terms of total body weight (g), total body length (cm) and % SGR. Concerning the composition of diets Prima diet had 43.92% crude protein and 12.17% lipid, Galaxy diet had 32.85% crude protein and 9.84% lipid, and Prawn diet had 42.81% crude protein and 6.36% lipid. Fish fed on Prima and Galaxy diets showed lower growth. The low protein content of Galaxy diet may be the reason for low growth of fish. Although, Prima diet has similar protein content to Prawn diet, the fish fed on Prima diet showed relatively low growth. The food consumption and FCR of fish fed on Prima diet was comparatively high. As Prima diet is in a powdered form, it may be due to wastage of feed. So when manufacturing a feed, pellet

size is very important and it should be compatible to different life cycle stages. The size of the pellets is adapted to the size of the fish so that the fish can grow as expected and it has been shown that growth rate of fish is closely related to the pellet size of feed (Wańkowski & Thorpe, 1979, Tabachek, 1988; Azaza et al 2010). In addition to that, protein quality in Prima and Prawn diets could be different but during the present study such differences (eg: amino acid profiles/ fatty acid profiles) were not taken in to consideration.

Nutrition has a direct effect on gonadal and hepatic development (Shim, 1989). In the present study significantly higher HSI values were observed in female fish compared to male fish. However, the HSI of female fish fed on three feeds showed no difference. GSI of males and females in three treatments were not significantly different. However, GSI of females were significantly higher than males because of their high weight in gonads.

Fish fed on Prawn diet produced significantly highest total number of larvae per tank. Shim and Chua (1986) had reported that there was no difference in fecundity of Guppy fed on 15% and 47% dietary protein levels. In the present study Prawn diet which produces highest number of fry, had 42.8% dietary protein content. However, no significant effect of experimental feeds on spawning frequency or mean gap between spawnings was observed among Guppy fed on different diets. In the present study larval quality was determined by the length of larvae which showed no significant difference among three treatments. Kithsiri et al (2010) also reported that the number of fry produced and their survival were also significantly higher in Guppy fish fed diets with higher dietary protein (43.6%) contents.

In fish farming industry, nutrition is a critical factor in an economic point of view, as feed represents 40-50% of production cost (De Silva and Anderson, 1994). Therefore, the feed cost should not be too high in a sustainable industry. The prices of the feed targeted for a single ornamental species vary dramatically compared to prices of feed for food fish, each of which is targeted for a specific species (Tamaru and Ako, 1999). However, many small scale aquarium keepers in Sri Lanka select fish feed on considering only the prices of feed (personal observations). When comparing prices, the Galaxy diet was the most expensive feed and Prima diet was the cheapest feed. Consequently, in many aquariums Prima diet is used as the feed for Guppy (personal observations). However, when considering the growth and reproductive performance, the Prawn diet was the best

out of three feeds. The fish fed on Prawn diet had the highest growth performance as well as produced highest number of larvae per tank. When comparing prices the prawn diet is comparatively cheap but produces better quality fish compared to other two diets. In addition to that the prawn diet showed the higher FCR value and fish farmer will get higher profit due to reduce feed cost as well as higher income for the higher number of larvae from the broodstock.

Therefore the present study clearly indicates that the Prawn diet is more suitable for Guppy in indoor aquaria when compared to Galaxy and Prima diets. The suitability of these diets for the guppy in outdoor ponds should be investigated further and the findings would be very significant in providing assistance in management practices for small scale ornamental fish farmers.

Table 1: Proximate composition of commercial diets (Prima, Galaxy and Prawn diets) used in the experiment.

Component	Prima	Galaxy	Prawn
Moisture (%)	12.4	3.6	11.0
Crude Protein (%)	43.9	32.8	42.8
Crude Lipid (%)	12.2	9.8	6.4
Ash (%)	9.6	10.7	3.9

Table 2: mean (\pm SD) Food consumption, FCR, growth performance and % survival of guppy fed with experimental diets. Means in a column with different superscripts are significantly different from each other ($p < 0.05$).

Diet	Mean Food consumption (% body weight day ⁻¹)	FCR	Mean total length (cm)		Mean body weight (g)		%SGR	%Survival
			male	female	Male	female		
			Prima	12.58 \pm 5.87	1.09 \pm 0.16	3.3 \pm 0.45 ^a		
Galaxy	12.31 \pm 6.26	1.18 \pm 0.20	3.1 \pm 0.47 ^a	3.9 \pm 0.4 ^a	0.25 \pm 0.1 ^a	0.84 \pm 0.29 ^a	1.91 \pm 0.11 ^a	100
Prawn	10.80 \pm 9.51	0.72 \pm 0.02	4.9 \pm 0.42 ^b	4.8 \pm 0.09 ^b	0.35 \pm 0.07 ^b	1.29 \pm 0.29 ^b	2.34 \pm 0.03 ^b	100

Table 3: Mean (\pm SD) Gonadosomatic Index (GSI) and Hepatosomatic Index (HSI) of guppy fed on three experimental diets, Prima, Galaxy and Prawn. Means in a column with different superscripts are significantly different from each other ($p < 0.05$).

Diet	GSI		HSI	
	male	female	male	female
Prima	0.03 \pm 0.01	0.26 \pm 0.13	0.01 \pm 0.01 ^a	0.04 \pm 0.01
Galaxy	0.03 \pm 0.00	0.15 \pm 0.06	0.03 \pm 0.01 ^a	0.05 \pm 0.03
Prawn	0.14 \pm 0.24	0.18 \pm 0.05	0.05 \pm 0.05 ^b	0.05 \pm 0.01

Table 4: Mean (+ SD) and range (min-max) of some reproductive parameters of *Poecilia reticulata* fed three different diets Prima , Galaxy and Prawn. Means in a column with different superscripts are significantly different from each other (p < 0.05).

Diet	Mean days to spawning	Mean interval of first spawnings in days	Mean number of spawning per tank	Mean number of larvae spawning	Mean total number of larvae per tank	Mean larval length (cm)
Prima	76.6 +2.1 (75-79)	2.4 ± 0.4 (1-6)	4.0 ± 0.00 (1-4)	2.4 ± 1.2 (1.5- 3.8)	8.3 ± 2.52 ^a (6-11)	1.10 ± 0.80 (0.5-2)
Galaxy	75.3 +12.0 (63-87)	3.6 ± 1.9 (1-11)	4.3 ± 2.06 (1-6)	4.9 ± 2.2 (3.2-7.5)	19.3 ± 3.79 ^a (15-22)	0.93 ± 0.05 (0.8-1)
Prawn	69.3 +8.1 (60-74)	4.5 ± 3.6 (1-14)	5.0 ± 1.00 (1-9)	4.1 ± 1.6 (2.8-5.9)	33.6 ± 7.51 ^b (26-41)	0.89 ± 0.05 (0.8-1)

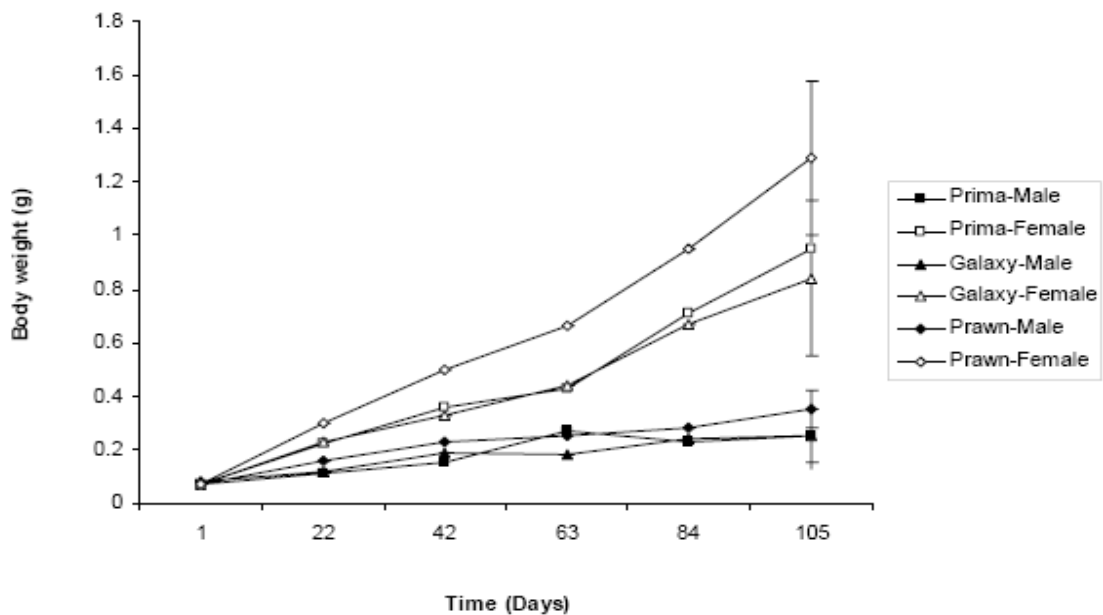


Fig 1. Mean body weight of *P. reticulata* males and females fed different commercial diets

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Conflict of interest

The authors wish to state that there is no conflict of interest associated with this scholarly work.

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