The Effects of Different Feeding Programmes on Growth and Survival Rates of New-born Guppy (Poeciliareticulata PETERS, 1859)

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Abstract

In this trial, five feeding programmes were used to investigate the optimum feeding process of new-born guppy in five treatment groups. For the study, fish were fed Artemia(nauplii) for 4 weeks (4A), microparticulated feed for 4 weeks(4MF), 1week Artemia+ 3weeks microparticulated feed (1A+3MF), 2weeks Artemia + 2weeks microparticulated feed (2A+2MF) and 3weeks Artemia + 1week microparticulated feed (3A+1MF) in related treatment groups. At the end of the study differences in weight, length, survival and stress resistance of the fish were calculated. According to the measurements, the best average growth of19.94±0.161 mm length and0.0732±0.00120 g weightwas observed in the group fed 4MF ($p<0.05$), whilst the worst average growth of17.74±0.088 mm lengthand0.0425±0.00061 g weight was observed in the group fed 4A ($p<0.05$).There were significant differences ($p<0.05$) in average lengths of18.93±0.038 mm, 18.27±0.055 mm, 17.97±0.025mm in the groups fed 1A+3MF, 2A+2MF and 3A+1MF respectively. The weights did not show any differencewith0.0594±0.00032g and 0.0576±0.00026g between the groups 1A+3MF, 2A+2MF ($p>0.05$),while the group 3A+1MF showed different live weight of 0.0490±0.00041g ($p<0.05$) according to other treatment groups. The worst survival rates with %88.14±0.74 has been obtained ($p<0.05$) in the group fed 4MF while the survival rates has been determined %97.78±0.00 in the group fed 3A+1MF, %97.04±0.74 in the group fed 4A and in the group fed 2A+2MF, %91.85±0.74 in the group fed 1A+3MF respectively. There were no significant differences between the groups fed 4A, 2A+2MF, 3A+1MF ($p>0.05$) while the groups 4MF and 1A+3MF showed significant differences ($p<0.05$). According to these results, the diet 4MF and 1A+3MF are not enough for a better aquaculture of new-born guppy. Therefore, it is found in the trial that Artemia supply for the first 2 weeks after birth in guppy are necessary for better survival and stress resistance.

Keywords:Poecilia reticulata, Artemia, Microparticulated feed.

1. INTRODUCTION

For many fish species, the larval period is considered critical in life history. Success of larval rearing depends mainly on the availability of suitable feed that is readily consumed, efficiently digested and that provides the required nutrients to support good growth and health (Giri et al., 2002). In general, the fish larvae are physiologically immature with little or no capacity to produce certain hormones and digestive enzymes, and they are dependent to a

greater or lesser extent on exogenous sources as live feed (Dabrowski, 1982, Lam, 1994; in Kumar et al., 2008). For this reason, it has been known that, since no artificial feed formulation is yet available to completely substitute for live feed, feeding live prey to young fish larvae still remains essential in commercial hatchery operations (Sorgelooset al., 2001). Hence, live feed is still the most preferred and reliable food organism in the rearing of fish larvae. In theornamental fish production, the fish also have commonly been fed live preyfor several days after hatching depending on the species. The major aim of the aquaculturists are to provide the fish larvae appropriate size of feed at the first feeding stage and to allow for better growth with higher survival rates.

However, the mouth-opening is enough to get the microparticulated artificial feed in new-born guppies. Despite the mouth-opening being large enough for exogenous feeding, use of live-feed in the culture of new-born guppy is important due to lower survival rates and weakness to the adverse conditions fish fed only microparticulated feed (OrtadoğuAkv., Pers. Comm., April 4, 2012; ŞirinyerAkv., Pers. Comm., April 4, 2012; Kayhan, S. Email Interview, Feb. 12, 2012; Clapsaddle, C., Email Interview, Feb. 01, 2012). For that reason, many freshwater ornamental fish farmers have shifted from only artificial feed to the cleaner Artemia nauplii to feed their young fish for the first few weeks after hatching.

Although Artemia is advantageous, it also has several disadvantages. The high price of Artemia cysts has increased the fish production making it one of the biggest outgoings at the ornamental fish farms. Many studies have been carried out both in marine larvae culture and ornamental fish larvae culture to determine the optimum period for Artemia feeding to solve this economical problem.

In this study, the effects of Artemia and microparticulated feed on growth, survival parameters and stress resistance have been calculated in new-born guppies. The optimum feeding period of the new-born guppy with Artemia was investigated.

2. MATERIALS AND METHODS

2.1.Experimental setup and the trial

Five treatments, including: Artemiafor 4 weeks (4A), microparticulated feed for 4 weeks(4MF), 1weekArtemia+3 weeks microparticulated feed (1A+3MF), 2weeks Artemia + 2weeks microparticulated feed (2A+2MF) and3weeks A + 1week microparticulated feed (3A+1MF) were fed to triplicate groups of new-bornguppies. The experimental setup has been illustrated in Figure 1.

Guppy fry were received from female broodstocks which allthe fish used in the experimentwereoriginated from the same strain. The trials were conducted in 9-Ltransparent plastic containers. After determination of the average length and weight of the fry (8.11 ± 0.21 mm total length 'TL' and 0.0064 ± 0.0006 g weight), new-born guppy were stocked at a density of 45 fish for each experimental tank (Itzkovich, 2011). The containers were continuously aerated and dissolved O2 was kept >7 mg.L-1. Water temperature was maintained at 26 ± 1 ºC and 12 h light/12 hdarkphotoperiod conditions were applied. Filtration was supplied with canister filters in order to filter the tap water in supply tank. % 30 of water was siphoned daily from the experimental containers for removing the uneaten food

and fish waste (Uslu, 2003). The tanks were refilled with filtered tap water from the supply tank after siphoned.

Measurements were taken every 7th day from the beginning of the trial until the end. On completion of the trial one final measurement was taken. The sample fish from all the replicates of five treatments were selected randomly and anaesthetized with clove oil (Kanyılmazet al.,2007). After anesthetization, lengths were measured and fish were weighed. The dissolved oxygen, temperature and pH parameters were monitored daily while ammonia, nitrite and nitrate parameters were monitored once a week.

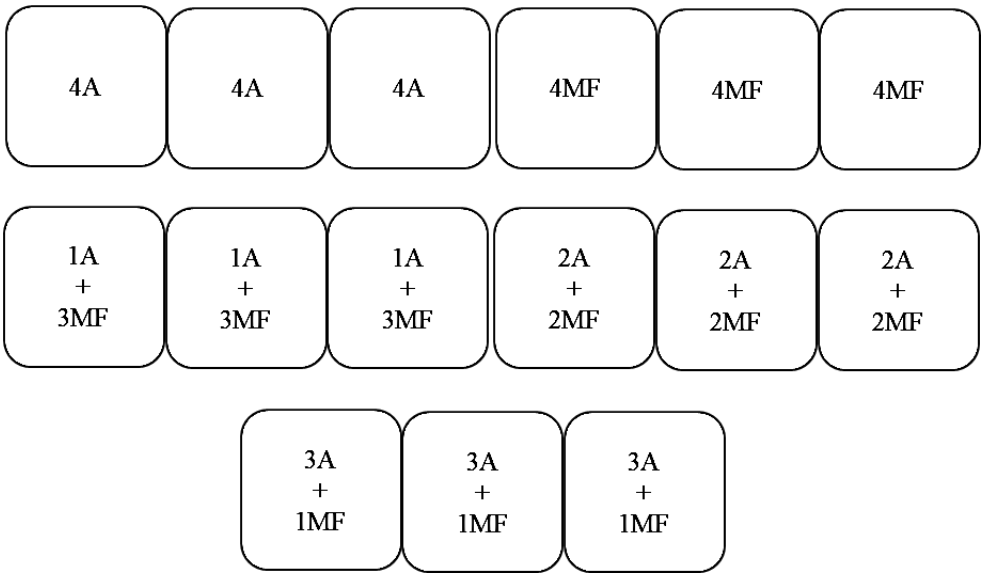

Figure 1Experimental setup

2.2.Feeds and feeding protocol

The fish were fed Artemianauplii and microparticulated feed throughout the study. As microparticulated feed, a new commercial artificial feed (ÇağatayEcobio, 300-500µ) was used on related treatment groups (Table 1). The microparticulated feed contains optimum levels of significant nutrients according to the information indicated at Shim and Ho (1993), Shim and Chua (1986) (Sales and Janssens, 2003).

Table 1 Nutritional Composition of the Microparticulated Feed1(MF) and Artemia1(%).

		MF	Artemia
Crude Protein	Min.	42	57
Crude Fat	Min.	6	13
Crude Cellulose	Max.	3	-
Crude Ash	Max.	9	8

1Obtained from the feed cards.

The requisite Artemia nauplii were obtained daily by hatching the decapsulated cysts. The decapsulatedArtemia cysts were placed into a cone shaped container and filled with >8 pH water. The temperature was set to 27-28 ºC and the salinity was adjusted to ‰ 33. Continuous strong aeration was carried out to the container and 2000 lux illumination was applied to the surface of water. Over 18-24 hours, nauplii were hatched. Feeding procedures was set to ad-libitum. Newly hatched naupliiwere supplied to treatment groups three times a day at a concentration of 1 nauplii mL-1 for the first 10 days and then 2 nauplii mL-1 on subsequent days. Hatched nauplii were stored at +4 ºC after use not to lose its nutritional values (Le´ger et al., 1983; in Lim et al., 2003).

2.3. Stress test

At the end of the experiment, sample fish were collected randomly from each replicate of the groups in order to determine the stress resistance. A stress test was used to evaluate the stress resistanceof the freshwater ornamental fish. The test entailed exposure of thefish to a certain amount of osmotic shock in a saline solution.Theoptimal salinity for stress tests using guppy fry reported to be 30 ‰according to procedures described by Lim et al.(2000). Hence, during the osmotic application, fish were subjected to osmotic shock in a500-mL beaker containing 500 mL of 30-ppt saline solution, made up of pre-aerated culture water and coarse salt. Themortality was monitored at 15-min intervalsover a 2-h period. The stress resistance of thefish werecalculated according to the number of survived fish recorded atreadings during the observation period.

2.4. Statistical analyses

Results were subjected to variance analyses (one-way ANOVA; $p< 0.05$) and followed by Tukey's multiple range testusing a software package SPSS 17.0 to determine the significant differences among treatment groups.

3. RESULTS

3.1. Growth

After average measurements were done at the beginning of the experiment, weight and length measurements were carried out on a weekly basis to evaluate the differences between the groups as a result of the protocols applied on nutrition programs. At the end of the first week of the trial, all groups showed approximately similar average live weight and length results ($p>0.05$).

In the second week measurements, the best growth results were obtained from the group 4MF ($p<0.05$).The groups 4MF and 1A+3MF were significantly different from each other ($p<0.05$) but the other groups showed no difference between themselves ($p>0.05$).

At the end of the third week, another measurement has been carried out. According to the results, the group 4MF showed the best growth ($p<0.05$). The groups 4MF, 1A+3MF and 2A+2MF were statistically different from each other ($p<0.05$) while the others did not show a difference on growth ($p>0.05$).

The last measurement has been done in the fourth week on completion of the trial. The group 4MF showed the best growth ($p<0.05$), while the group fed only Artemia (4A) showed the worst live weight and length results ($p<0.05$). The groups1A+3MF and 2A+2MF did not show a significant difference ($p>0.05$) in terms of weight while the lengths were significantly different from each other ($p<0.05$). The group 3A+1MF also showed significant difference for the weight measurements ($p<0.05$) but the lengths were not significantly different from the groups 4A and 2A+2MF ($p>0.05$), although the groups 4A and 2A+2MF differ from each other.The average live weights were shown in Table 2 and Figure 2 and the lengths were shown in Table 3 and Figure 3.

Table 2Average live weights recorded at weekly measurements (g).

Groups	Measurements				
	Initial	1. Week	2. Week	3. Week	4. Week
4A	0.0064±0.0006	0.0103±0.00012	0.0161±0.00015c	0.0349±0.00029d	0.0425±0.00061d
4MF	0.0064±0.0006	0.0104±0.00006	0.0219±0.00024a	0.0569±0.00017a	0.0732±0.00120a
1A+3MF	0.0064±0.0006	0.0103±0.00006	0.0196±0.00020b	0.0475±0.00027b	0.0594±0.00032b
2A+2MF	0.0064±0.0006	0.0103±0.00010	0.0162±0.00021c	0.0436±0.00026c	0.0576±0.00026b
3A+1MF	0.0064±0.0006	0.0102±0.00012	0.0157±0.00015c	0.0352±0.00012d	0.0490±0.00041c

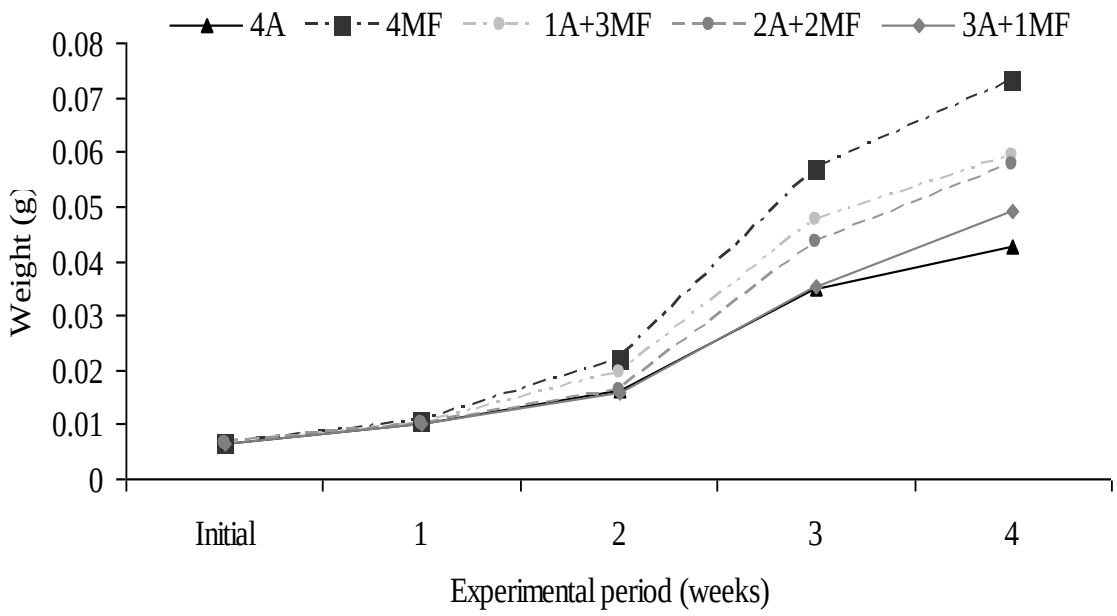

Figure 2 Graphical representation of live weights recorded at weekly measurements

Table 3 Average lengths recorded at weekly measurements (mm).

Groups	Measurements				
	İnitial	1. Week	2. Week	3. Week	4. Week
4A	8.11±0.21	11.54±0.023b	12.77±0.018c	15.11±0.024d	17.74±0.088d
4MF	8.11±0.21	12.01±0.018a	14.50±0.031a	17.19±0.035a	19.94±0.161a
1A+3MF	8.11±0.21	11.52±0.042b	13.91±0.024b	16.92±0.114b	18.93±0.038b
2A+2MF	8.11±0.21	11.56±0.035b	12.76±0.031c	16.16±0.031c	18.27±0.055c
3A+1MF	8.11±0.21	11.51±0.018b	12.71±0.042c	15.13±0.029d	17.97±0.025cd

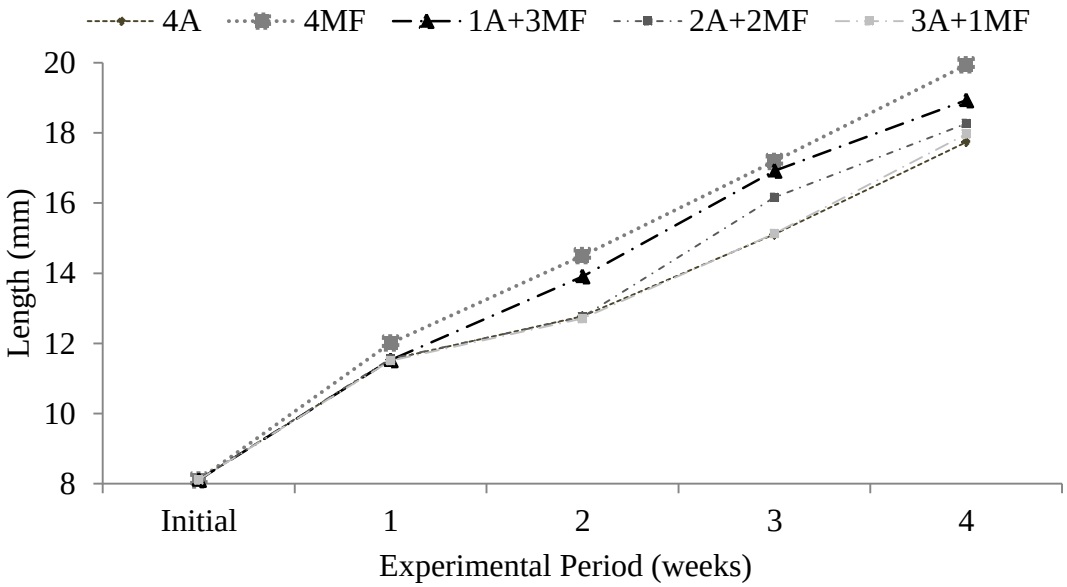

Figure 3Graphical representation of the lengths recorded at weekly measurements

3.2. Survival

As a result of observations on each experimental tank, dead fish were recorded daily during the experiment. At the end of the study, survival rates were calculated according to numbers of live and dead fish (Table 4). In consequence of survival data, the fish fed 3A+1MF diet showed the highest survival rates %97.78. The group fed only Artemia and the group fed 2A+2MF also showed better survival rate with both %97.04. The worst survival rates have been obtained from the group fed only MF with %88.14 and followed by the group fed 1A+3MF with %91.85. According to the statistical analyses, the groups 4A, 2A+2MF, 3A+1MF were not different from each other ($p>0.05$), while the groups 4MF and 1A+3MF were both different ($p<0.05$).

Table 1Survival rates of new-born guppy fry fed different feeding programs (%).

Groups	4A	4MF	1A+3MF	2A+2MF	3A+1MF
Survival Rates	97.04±0.74a	88.14±0.74c	91.85±0.74b	97.04±0.74a	97.78±0.00a

3.3. Stress Test Results

The stress resistance of the fish were calculated during the observations which have been done 15 minutes intervals over 2 hour period. The fish fed 4A and 3A+1MF have shown the best stress resistance between all treatment groups. There were not significant differences among these two groups despite the others were different from each other. Following groups can be listedas 2A+2MF, 1A+3MF and 4MF according to their stress resistance and stamina. The first deaths have been observed in the groups 4MF in the 30th minutes (Table 5, Figure

4). The deaths in all groups have been seen in the 60th minutes. At the end of the application, there were no alive fish in the group 4MF while the survival rate was %30 in the groups fed 4A and 3A+1MF.

Table 5Survival rates of new-born guppy exposed to salinity stress test.

Groups	Survival data recorded at 15 min. intervals (%)								
	0	15	30	45	60	75	90	105	120
4 A	100.0	100.0	100.0	100.0	80.0	63.3	56.6	53.3	30.0
4 MF	100.0	100.0	96.6	83.3	66.6	50.0	23.3	6.6	0.0
1 A+3 MF	100.0	100.0	100.0	96.6	76.6	60.0	46.6	16.6	10.0
2 A+2 MF	100.0	100.0	100.0	90.0	73.3	70.0	40.0	26.6	23.3
3 A+1 MF	100.0	100.0	100.0	100.0	86.6	66.6	56.6	40.0	30.0

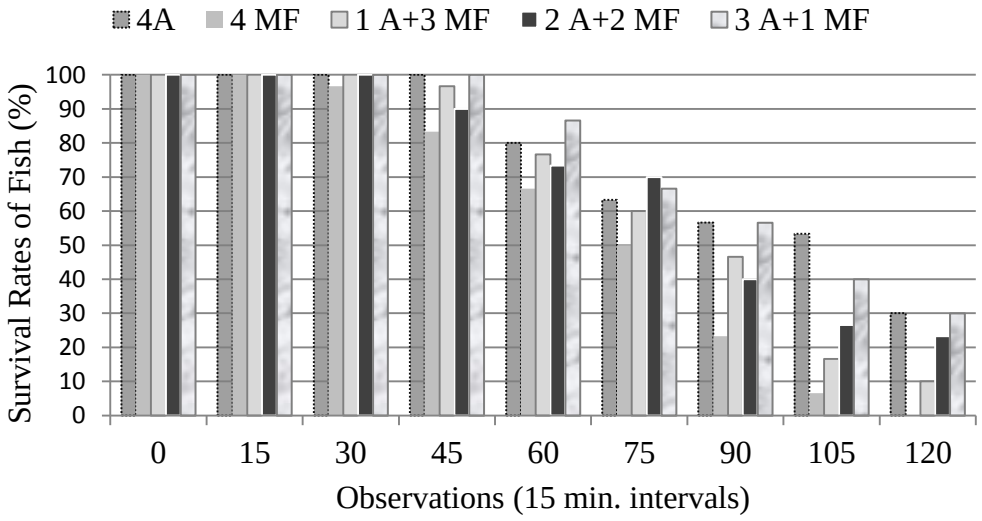

Figure 4 Graphical demonstration of the stress test exposed to new-born guppy

4.DISCUSSION

In this study, new-born guppy showed good feeding response to both Artemia and microparticulated feed. However, the fish fed 4MF diet ended up with a high performance growth according to other treatment groups ($p<0.05$). In the first measurement, the weights of the fish did not differ from each other ($p>0.05$). But for the lengths, four groups including 4A, 1A+3MF, 2A+2MF, 3A+1MF resulted in the same growth rate ($p>0.05$) while 4MF

outrivaled the others ($p<0.05$). In the second week of the trial another measurement has been performed and 3 different growth grades have been obtained from the statistical analyses. The groups 4MF and 1A+3MF were significantly different ($p<0.05$) in terms of live weight and length but the other groups did not show any difference($p>0.05$). In the following measurement, the groups 4MF, 1A+3MF, 2A+2MF all showed better weight gain and increase in length in contrast to 3A+1MF and 4A groups respectively. The groups 4MF, 1A+3MF and 2A+2MF were statistically different from each other ($p<0.05$) while the others did not show a difference on growth ($p>0.05$).At the end of the trial, the last measurement has been done and the best growth results were obtained from the group fed 4MF ($p<0.05$), while the group fed only Artemia (4A) showed the worst growth ($p<0.05$). The other groupscould be arrayed as 1A+3MF, 2A+2MF and 3A+1MF according to growth of the fish depending upon the statistical analyses.Herein, it is clear to see the positive effect of used artificial feed on growth of new-born guppy.

However, the survival rates were not the same as growth between the treatment groups. The highest survival rates obtained from the groups 3A+1MF, 2A+2MF and 4A respectively. According to data obtained from the measurements and observations have done during the experiment, the fish fed 4MF diet showed better growth while they have had lower survival rates. In spite of that, the fish fed 4A diet showed lower growth although they have had higher survival rates. Therefore, as is clear from here, Artemia weighted diets have resulted in better survival rates despite they cause lower growth in new-born guppies.

Another application has been carried out to determine the stamina of the fish fed different feeding programs. The salinity stress test used in the trial is one of the stress resistance determining tests developed for new-born guppies. The groups 4A and 3A+1MF showed the best survival rates according to stress test results. The groups fed MF weighed diets resulted in lower stress resistance. Thus, the stress resistances of the fish have given similar results to the survival data of the fish during the trial. It is clear that, Artemia increased the stamina of the fish in contrast to MF in this trial.

In a similar study, Başçınar and Çakmak, (2010) have investigated the growth performance of Black Sea Trout larvae fed Artemia and granulated feed. According to the results, they have found that the larvae grew better fed only granulated feed for the first 45 days. However, the survival rates were not high in the groups fed Artemia in contrast to this trial. Callan et al., (2003), also have made another experiment to investigate the early weaning of Gadusmorhua larvae from Artemia to artificial feed. They have found that the groups fed 100% A, 50% A and 25% A diets did not differ significantly in standard length, dry weight, specific growth rate or survival. However, the microparticulated diet treatment has had lower growth and survival rates than any of the treatments receiving Artemia. Çalım, (2010) has investigated the effects of Artemia and microcapsule feed on guppy fry, and has found that the growth and survival data were not as well as the fry fed Artemia. In another trial, Kaiser et al., (2003) have found that the larvae (Carassiusauratus) fed Artemia or Artemia + commercial food have showed better growth and survival rates than the fish fed only commercial food.

In many studies, Artemia and artificial feed diets show different growth and survival results due to species and other conditions. There are several researches have been already done about the first feeding of new-born guppy. According to the data obtained from these experiments prove that, the use of Artemia nauplii for the feeding of guppy-fry increases the growth and survival. However, being one of the biggest expenditures of ornamental fish

farms, use of Artemia is an important issue for the farmers. Several interviews followed out with the fish-farmers (OrtadoğuAkv., Pers. Comm., April 4, 2012; ŞirinyerAkv., Pers. Comm., April 4, 2012)to investigate the feeding protocols of the culture of new-born guppies and to consider the use of Artemia in ornamental fish farms. According to interviews, the use of Artemia as live feed for the culture of new-born guppy have been expressed as necessary for the first few weeks after birth. The Artemia has been rendered as breast-milk for new-born guppies due to its effects on increased survival and stamina. Person le Ruyet (1993) has also indicated that, reducing the live prey utilization in larvae increases the Artemia savings for the early culture of fish. However, this may lead to deaths, lower juvenile quality, including skeletal abnormalities.

It is already known artificial feeds got ahead in time and increase the growth and survival much better in comparison to back. It is because of the recent studies which have provided better understanding of digestion mechanisms in larvae and have led to proposed dietary compositions meeting larvae nutritional requirements. The biochemical studies have also shown that most of the digestive enzymes are present in young larvae to digest the artificial feed (Cahu and Infante, 2001). Therefore, artificial feeds are being improved rapidly to meet the needs of larvae. But total replacement of live prey is still formidable for now. For this reason, Artemia is still the most important live feed in the culture of new-born guppy and highly important for a better growth, survival and stamina.

In this trial, the efficient use of Artemia and microparticulated feed were investigated. According to the results Artemia supply to the fish increased the survival and stamina. As a result, the use of Artemia on new-born guppy for the first 2 weeks after birth has been found necessary for better survival and stress resistance.

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