IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 8, Issue 6 Ver. I (Jun. 2015), PP 06-11
www.iosrjournals.org

Larval rearing of freshwater Angelfish (*Pterophyllum scalare*) fed on different diets

Samiran Patra & T.K.Ghosh

Department Of Aquaculture., Faculty Of Fishery Sciences West Bengal University of Animal and Fishery Sciences 5, Buderhat Road, Panchasayar, Kolkata – 700 094

Abstract: *In this present study we find the survival rate (%) , growth rate (g) of angelfish (Pterophyllum scalare) larvae fed on different diets like Artemia, Rotifer, Moina, Ceriodaphnia, egg custard and green water. The mean survivable rate (%) after 20 days observation were 74.67% for Artemia, 68.33% for rotifer, 70.89% for Moina, 29.46% for Ceriodaphnia, 31.19% for egg custard and 23.72% for green water (Table.3.1). The survivable rate (%) is greater in Artemia than Moina, rotifer, egg custard, Ceriodaphnia and green water respectively. The highest growth rate 11.1 mm was observed in case fed by Artemia after 20 days of culture and lowest 4.8 mm was found in Ceriodaphnia (Table.3.2). The average 28 days required for live feed taken by the spawn cultured, maximum 36 days and minimum 24 days required respectively and diseases occurrence also observed during this study.*

Key word: *Angelfish, Survival rate, fish feed.*

I. Introduction:

Pterophyllum scalare today is one of the most popular aquarium fish in the world. The first angelfishes were imported into Hamburg; Germany in 1909. Its introduction in USA in the year of 1911, they have unique position in the fish keeping world. Freshwater ornamental fish trade is a million-dollar industry (Lim and Wong, 1997). Angelfish have been called the 'kings of the aquarium'. Their native habitat is the Central Amazon. Angelfish (P. scalare) is originated from a branch of the Amazonas River (Tapajoz River), at the north of Brazil (Soriano-Salazar and Hernández-Ocampo, 2002). Angelfish is considered an omnivorous nature; its feeding is based on the consumption of plankton, larvae of insects and crustaceans, plants and worms (Soriano-Salazar and Hernández-Ocampo, 2002). Angelfish fry accept very few foods at an early age (Elieson, 2008**).** Angelfish represents one of the most important ornamental cichlid species, but amongst the main constraints to its optimal commercial production, is the lack of knowledge on proper diets for the different life stages (Luna-Figueroa et al., 2000). In captivity, the common live larval food used for growing of most ornamental fish is limited to macro-zooplankton such as Moina, Daphnia and Artemia nauplii (Lim and Wong, 1997). Although it is known that the angel fish accepts artificial diets (Luna-Figueroa et al., 2000), lower growth and survival rates of P. scalare are commonly obtained when such diets are used as the sole feed (Luna-Figueroa, 1999), mainly during the fry and juvenile stages (Hofer, 1985). Nutritional requirement of fishes vary with some factors such as the relationship between the diet and life stage (Ricker, 1979) and therefore, the dietary content for feeding larvae is different to that needed for reproduction or for growth of juveniles. But as a common practice for culturing angel fish, on-growing diets are also used to promote its reproduction (Pérez et al., 2002; Luna- Figueroa, 2003). Thus, the undiscriminating use of diets for the different live stages of P. scalare is normally associated to different biological responses, as pointed out in few nutritional reports (Luna-Figueroa et al., 2000; Soriano-Salazar and Hernández-Ocampo, 2002; Luna-Figueroa, 2003). The success in the hatchery production of fish fingerlings for stocking in the grow-out production system is largely dependent on the availability of suitable live food organisms for feeding fish larvae, fry and fingerlings. In contrast, the industrial development of freshwater ornamental fish culture has been hampered by the lack of suitable live feeds for feeding the fish at the various production stages (Dhert, 1996).

Currently, inert food items such as egg yolk suspension, milk powder or powdered feeds and natural plankton bloom induced by artificial fertilization of water are used in larval feeding, and Moina and Tubifex. Many freshwater ornamental fish farmers have shifted from Moina to the cleaner Artemia nauplii for feeding their young fish. As the nauplii (length of instar-1 Artemia < 0.55 mm) are only half the size of Moina (length < 1.20 mm), it is necessary to look for bigger organisms, both to fill in the size gap, and as a substitute of Tubifex for feeding larger fish such as brooders. Furthermore, the high price of Artemia cysts has increased the fish production cost, and cheaper alternative diets with comparable nutritional quality are needed to maintain the cost competitiveness of ornamental fish in the global market (Lim et al., 2003). Therefore, the present work evaluates the effect of different diets on growth and survival rate (%) larvae of angelfish cultured under laboratory conditions, and using five different diets like Artemia, rotifer, Moina, Ceriodaphnia, egg custard and green water.

II. Materials and Methods:

This study was performed under laboratory conditions in the department of Aquaculture, Faculty of Fishery Sciences at Chackgaria under the West Bengal University of Animal and Fishery Sciences.

Fish Larvae: After 5 days of hatching, angelfish spawn were used for this study.

A. Water quality:

Throughout the study, experiment was maintained under the following water parameters:

Table 2.1. Physico-chemical parameters of bore-well water.

Parameters	Bore-well water
Temperature (^{0}C)	26-29
P^H	7.0-7.8
DO. (ppm.)	6.6-8.5
Alkalinity (mg/l)	560 (n = 6)
Hardness (mg/ l)	762.6(n = 6)
Salinity (ppt.)	4.0-5.0

Water quality was maintained by bio-filtration and total water changes were performed every 7 days. The physico-chemical parameters were measured by using the standard methods of APHA (2005).

B . Materials used in the experiments and its specification:

2.2. Table:

No. of tanks	Size of tanks (cm)	Purpose
5	60×30×30	Larval rearing tank
3	120×57×39	Moina culture tank (Rectangular FRP tank)
2	120×57×39	Daphnia culture tank (Rectangular FRP tank)
3	44×25×25	Rotifer culture tank
1	5 liter capacity	Artemia hatching jar.
1	-	Plankton net

2.3. Instruments:

Instruments	Specific range
Glass thermometer	20-34^{0}C
P^H pen / P^H Paper	0-14
Salino meter	0-20 ppt
Immersion Thermostat	20 – 34 ^{0} C
Electronic balance	0.02 g– 600g
Microscope (Olympus, CH 20 i)	10x/0.25,40x/0.65,100x/1.25
Kodak camera	8.0 mega pixels

2.4. Disinfectants:

Disinfectants	**Doses**	**Purpose**
$KMnO_4$	2 mg/liter	Antifungal agent
Methylene blue	(1g/liter).	Antifungal agent
Red all	5ml/50 liter water for larval rearing	Antifungal agent
Aqua blue	4-5 drops/50 liter water	Purification of water
Pursue.	8ml/5 liter	Antifungal agent

2.5. Others materials:

Name of materials	**Rate/Description/Purpose**
Biological filter	Filtering water
Plankton net	For plankton collection
Scale	For measurement
Bulb (230 v.)	For illumination of tanks
Aerator	For aeration
Power filter	Both filtering and aeration of tank water
UG filter	Filtering of water
Calculator	For calculation
Test tube with stand	For pure culture of zooplankton
Dropper	For collections of zooplankton
Double distilled water	For water quality parameters
Slides, absorbent	For microscopic observation
Siphoning pipe	Cleaning of aquarium

C. Larval rearing:

Survival rate (%) of fry fed on different diet (Artemia, Rotifer, Moina, Cerodaphnia, Egg custard):

For this experiment five larval rearing tanks were taken and each filled with bore well water up to 15 cm. Then seven days old angelfish fry were released @ 100 nos. / tank. The fry in different tanks were fed with different diet i.e., Artemia, rotifer, Moina, Cerodaphnia and egg custard. Then observations were taken for survivable rate (%) at an interval of 5 days 10 days, 15 days and 20 days. The survivable rate (%) was noted at different days.

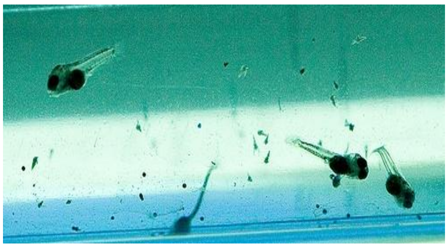

Fig. 1. Larval Feeding

Fig. 2. Methylene blue used in aquarium water

Experiment 4: Time (hrs) taken for live feed (Tubifex) acceptance by the 28 days old fry.

After larval rearing with different diet the fry become grown up. They were taken live feed like tubifex. This experiment was done for time taken for taking live feed as tubifex.

III. Result:

3.1: Survival rate (%) of fresh water angelfish larvae fed on different diets:

Survival rate (%) of angelfish larvae fed on different diets like Artemia, rotifer, Moina, Ceriodaphnia, egg custard and green water were different using different diets. The mean survival rate (%) after 20 days observation were 74.67% for Artemia, 68.33% for rotifer, 70.89% for Moina, 29.46% for Ceriodaphnia, 31.19% for egg custard and 23.72% for green water (Table.3.1). It was found that there was no significant difference in length (mm) between Artemia and Moina and incase of rotifer and Moina at 5% level (Table.3.1) ($p<0.05$, n=5). In figure (3) are shows that the survivable rate (%) is greater in Artemia than Moina, rotifer, egg custard, Ceriodaphnia and green water respectively.

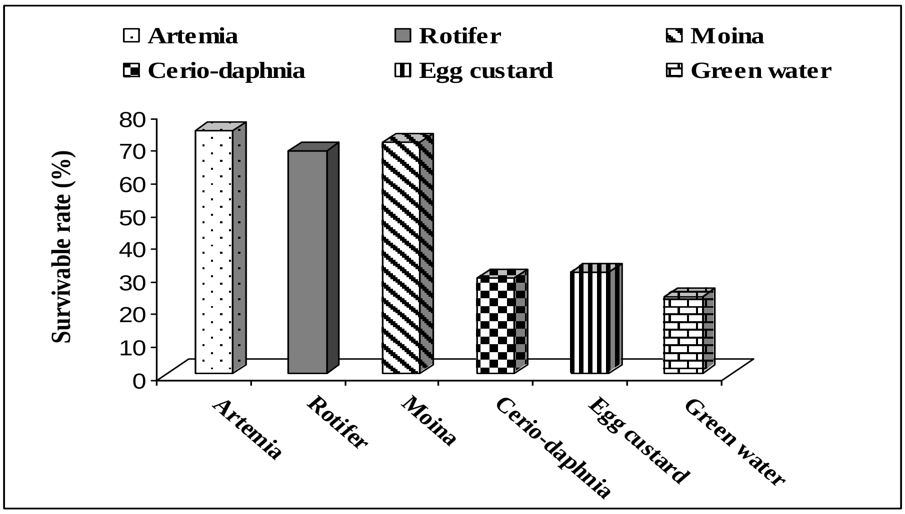

Fig.3: Relation between survival rates (%) in different diets.

Table 3.1: Survival rate (%)* of fresh water angelfish larvae fed on different diets (Mean ± Standard Error).

No. of observations	Diet types					
	Artemia	Rotifer	Moina	Ceriodaphnia	Egg custard	Green water
Day-5	85.0	77.4	82.01	45.01	56.32	32.03
Day -10	78.2	72.6	76.23	32.43	45.04	28.54
Day -15	76.5	69.1	72.56	30.15	32.09	25.12
Days -20	74.67	68.33	70.89	29.46	31.19	23.72
Mean ± Standard Error						
	78.59 ±2.25[a]	71.86±2.07[b]	75.42±2.46[ab]	34.26±3.64[c]	41.16±5.96[d]	27.35±1.86[e]

*** Values in row having a common superscript letter are not significantly different ($p<0.05$)**

3.2: Growth rate (length in mm) of fresh water angelfish larvae fed on different diets

The best growth was attained with diet Artemia, reaching 11.1 mm in length, and 7.0 mm, 6.5 mm, 4.8 mm, 5.0 mm, and 5.5 for rotifer, Moina, Ceriodaphnia, egg custard, green water respectively after 20 days culture. In figure (4) was observed that the growth rate (mm**)** is greater in Artemia than Moina, rotifer, egg custard, Ceriodaphnia and green water respectively. There was no significant difference between rotifer and Moina.

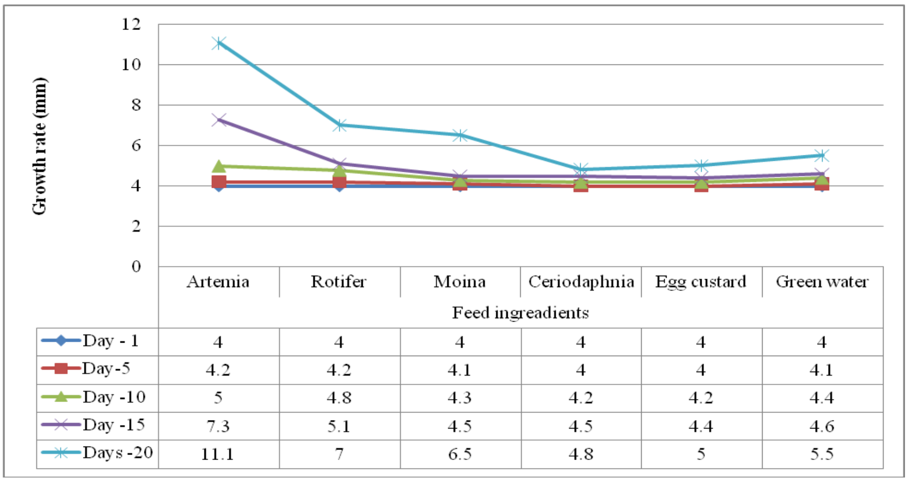

Fig.4: Relation between growth rates (%) in different diets.

Fig.5: Angel fish fry after 6-7 weeks culture in aquarium.

3.3: Acceptability of live feed: The difference between date of hatching and date of live food (Tubifex) taken.

It was observed that, live food acceptability varied from different observations (Fig.6). The highest 36 days and lowest 24 days was observed and in an average 28 days required.

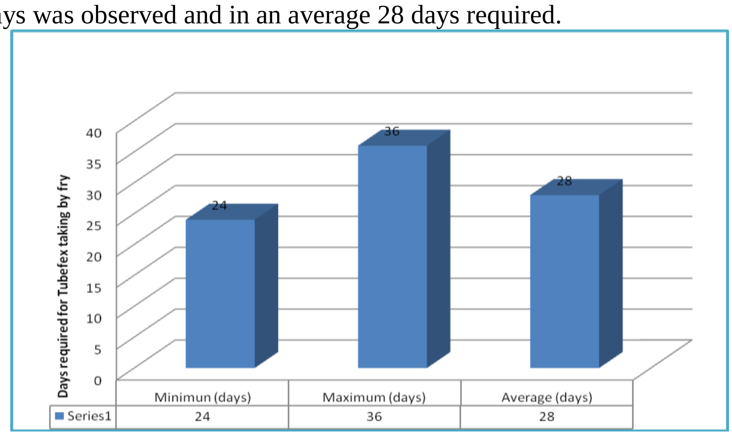

Fig.6: Relation between live food (Tubifex) taking duration of spawn in different observation (n=18)

Fig.6: Fry (8 weeks) fed on Tubifex

IV. Discussion:

Survival rate (%) of angelfish larvae fed on different diets like Artemia, rotifer, Moina, Ceriodaphnia, egg custard and green water was observed. The mean survival rate (%) after 20 days observation were 74.67% for Artemia, 68.33% for rotifer, 70.89% for Moina, 29.46% for Ceriodaphnia, 31.19% for egg custard and 23.72% for green water (Table 3.1). Figure shows that the survivable rate (%) was greater in Artemia than Moina, rotifer, egg custard, Ceriodaphnia and green water respectively. It was indicate that Artemia nauplii give better result. The same observation was observed by Lim et al., (2002a) use of Artemia nauplii has been demonstrated in a recent study on the culture of fry and adults of the guppy (Poecilia reticulata). Results showed that while there was no difference in stress resistance, the growth performances of the guppy fry and adults fed Artemia nauplii for 4 weeks were significantly better than those fed Moina. Guppy adults fed Artemia nauplii also survived significantly better than those fed Moina. Another study on freshwater ornamental fish in Singapore has demonstrated the use of Artemia nauplii in the feeding of Brown Discus (*Symphysodon aeuifasciata axelrodi*) (Lim and Wong, 1997). But in our present study it was found that Artemia gives the highest survival rates (%). It was also observed that there was less difference in survival rates (%) which were fed by rotifer and Moina. So, Moina or rotifer can be used as substitute for Artemia. Lim and Wong (1997) were demonstrated in recent, use of the freshwater rotifers B. calyciflorus in the larviculture of freshwater ornamental fish dwarf gourami (*Colisa lalia*) in Singapore. It was highly cost effective for rearing of fry. Shiri et. al., (2003) successfully cultured the Burbot (*Lota lota*) larvae, endangered fresh water fish in Western Europe with fresh water rotifer, B. calyciflorus. They obtained survival rate of 69.2% in the fry, fed with rotifer. Food, enriched with rotifer enhanced growth and survival rate of fry (Craig et. al., 1994; Rimmer et. al., 1994; Cho et. al., 2001; Castell et. al., 2003; Mercier et. al., 2004). Survival rate of larvae fed with rotifers was 65.1–74.5%, which was four times higher than those fed with egg yolk particles Lim et. al., (2002a), used artemia nauplii for culture of fry and adults of the guppy (Poecilia reticulata). According to him, there was no difference in stress resistance, but the growth performance of guppy fry and adults fed with artemia nauplii for 4 weeks was significantly better than those fed with Moina, also observed that survival rate of Discus juveniles after feeding on artemia nauplii and Moina for 2 weeks and survival rate (%) 90.0 and 78.3%.

The growth was attained with diet Artemia, reaching 11.1 mm in length, and 7.0 mm, 6.5 mm, 4.8 mm, 5.0 mm, and 5.5 for rotifer, Moina, Ceriodaphnia, egg custard, green water respectively after 20 days culture. It was observed that Artemia gave the highest growth rate (mm). In case of rotifer and Moina there was less difference between them. It was indicate that farmers can use rotifer or Moina instead of Artemia. Present study revealed that, angel fish larvae are able to accept both live feed and dry feed at the onset of feeding. However, larvae solely fed live feed showed comparatively higher growth performances than that of larvae exclusively fed dry feed. Similar observation has also been reported for Danio rerio (Carvalho et al. 2006), Heterobranchus. Longifillis (Kerdchuen & Legendre 1994), southern flounder, Paralichthys lethostigma (Faulk & Holt 2009), haddock (*Melanogrammus aeglefinus*) (Blair et al. 2003) and Whishker cat fish (*Macronema bleekeri*) (Dan 2008). Well developed digestive system with functional digestive enzymes are absent at the onset of feeding and exogenous enzymes from live feeds play an important role in digestion (Person 1989; Dbrowski 1982). Therefore, the least growth performances observed in larvae exclusively fed egg custard could be attributed to a less developed digestive system which cannot support fish larvae to fully digest artificial dry feed. Low ingestion rate of dry feeds and leaching nutrients from dry feeds have also been highlighted as factors behind the poor growth in fish larvae fed dry feeds (Muguet et al. 2011). Moreover, physical properties of feeds (Sarkar et al. 2006), developmental stage specific nutritional requirement of larvae are also responsible for the poor growth of larvae exclusively fed formulated feeds (Flüchter 1982).

It was observed that, live food acceptability varied from different observations (Fig.6). The highest 36 days and lowest 24 days was observed and in an average 28 days required.

Economics of seed production:

Economically seed production of P. scalare was compared between using two types of live feed (Artemia and Moina) in bore-well water. It was found that, in natural breeding and induced breeding net income was Rs. 8,561.2, 7700.2 and 15,582 and 14,267 using Artemia and Moina for 20 days larval rearing respectively. The net income was always higher in induced breeding than natural breeding. This due to high hatching rate (%) and increased survival rate in induced breeding. The economy of seed production using Artemia slightly higher than Moina.

Acknowledgments:

The authors wish to thank the Dr. T. K. Ghosh, Reader, Department of Aquaculture, Chackgaria, WBUAFS for providing necessary facilities for carrying out the research work.

Reference:

[1]. Alexander, F. 1985. An Introduction to Veterinary Pharmacology. Churchill Livingstone Inc., New York. 429 pp.
[2]. APHA-AWWA-WEF. (2005). Standard methods for the examination of water and waste water. American Public Health Association. Washington DC. USA.
[3]. Blair T, Castell J, Neil S, D'Abramo L, Cahu C, Harmon P, Ogunmoye K (2003) Evaluation of microdiets versus live feeds on growth, survival and fatty acid composition of larval haddock (Melanogrammus aeglefinus). Aquaculture 225:451–461.
[4]. Carvalho AP, Araújo L, Santos MM (2006). Rearing zebrafish (Danio rerio) larvaewithout live food: evaluation of a commercial, a practical and a purifiedstarter diet on larval performance. Aquacult Res 37:1107–1111.
[5]. Castel, J., Blair, T., Neil, S., Howes, K., Mercer, S., Reid Young-Lai, J., Gullison, B. and Dhert, P., Sorgeloos, P., 2003. The effect of different HUFA enrichment
[6]. Cho, S.H., Hur, S.B. and Jo, J.Y., 2001. Effect of enriched live feeds on the survival and growth rates in the larval Kotean rockfish, Sebates schlegeli Hilgendrof. Aquacult. Res. 32 (3), 199.
[7]. Craig, S.R., Connie, R. and Holt, J.G., 1994. The effects of enriching live foods with usaturated fatty acid composition of larval red drum, Sciannops ocellatus. J. World aquacult. Soc. 25(3), 424-434.
[8]. Dan BC (2008) Effects of feeding regime and stocking density on survival and growth of Whisker Catfish fry (Micronema bleekeri, Gunther). MSc Thesis, Asian Institute of Technology (AIT), Bangkok, Thailand, p 99p.
[9]. Dbrowski K (1982) Proteolytic enzyme activity decline in starving fish alevins and larvae. Environ Biol Fishes 7:73–76.
[10]. Dhert, P., 1996. Rotifers. In: Lavens, P., Sorgeloos, P. (Eds.), Manual on the Production and Use of Live Food for Aquaculture. FAO Fisheries Technical Paper, vol. 361. FAO, Rome, pp. 49– 78.
[11]. Elieson, M., 2008. Food for fry. Cichlid-Forum.com. Accessed on 28 September, 2008.
[12]. Enquist, M., Plane, E. and Roed, J., 1985. Aggressive communication in fulmars (Fulmarus glacialis) competing for food. Animal Behaviour 33, 1007-1020.
[13]. Faulk CK, Holt GJ (2009). Early weaning of southern flounder, Paralichthys lethostigma, larvae and ontogeny of selected digestive enzymes. Aquaculture 296:213–218.
[14]. Flüchter J (1982). Substance essential for metamorphosis of fish larvae extracted from Artemia. Aquaculture 27:83–85.
[15]. Hofer, R. 1985. Effects of artificial diets on the digestive process of fish larvae. Nutrition and Feeding of Fish. In: C. Cowey, A. Mackie and J. Bell, editors. Academic Press, London, UK, pp. 213-216.
[16]. Kerdchuen N, Legendre M (1994). Larval rearing of an African catfish, Heterobranchus longifilis, (Teleostei, Clariidae): a comparison between natural and artificial diet. Aquat Living Resour 7:247–253.
[17]. Lim, L. C. and Wong, C. C. 1997. Use of the rotifer, Brachionus calyciflorus Pallas, in freshwater ornamental fish larviculture. Hydrobiología. 358:269-273.
[18]. Lim, L.C., Cho, Y.L., Dhert, P., Wong, C.C., Nelis, N. and Sorgeloos, P., 2002a. Use of decapsulated Artemia cysts in ornamental fish culture. Aquac. Res. 33, 575– 589.
[19]. Lim, L.C., Dhert, Ph., Sorgeloos, P., 2003. Recent developments in the application of live feeds in the freshwater ornamental fish culture. Aquaculture 227 (2003) 319–331.
[20]. Luna-Figueroa, J. 2003. Pterophyllum scalare (Pisces: Cichlidae): Influencia de alimento vivo en la reproduccióny el crecimiento. II Congreso Iberoamericano Virtual de Acuicultura, CIVA 2003 (http:// www.civa2003.org), pp.55-65 (20 de julio de 2005).
[21]. Luna-Figueroa, J.; Figueroa-Torres, J. y Hernández de la Rosa, L. P. 2000. Efecto de alimentos con diferente contenido proteico en la reproducción del pez ángel Pterophyllum scalare variedad perlada (Pises: Cichlidae). Ciencia y Mar. 4:3-9.
[22]. Mercier, L., Audet, C., Joel de la, N., Parent, B., Parish, C.C., and Ross, N.W., 2004. First feeding of winter flounder (Pseudopleronectus americanus) larvae: use of B. plicatilis acclimated at low temperature as live prey. Aquaculture 229 (1-4), 273-278.
[23]. Mills, D., D. Sands, and P.W. Scott. 1988. The Concise Encyclopedia of Tropical Aquarium Fishes. Crescent Books, New York. 320 pp.
[24]. Muguet JB, Lazo JP, Conklin DE, Piedrahita RH (2011). Evaluation of weaning performance of California halibut (Paralichthys californicus) larvae using growth, survival and digestive proteolytic activity. Aquacult Nutr 17:486–493.
[25]. Pérez, C. E.; Morales, S. I. y Olvera, Q. H. 2002. Frecuencia de desove de diferentes variedades del pez angel Pterophyllum scalare (Pisces: Cichlidae). AquaTIC2002. 16:1-7.
[26]. Person L (1989) Early weaning of marine fish larvae onto microdiets: Constraints and perspectives. Advances in Tropical Aquaculture, Tahiti (French Polynesia), http://archimer.ifremer.fr/doc/00000/1422/
[27]. Ricker, W. E. 1979. Growth rates and models. Fish physiology, Vol. VIII, Bioenergetics and growth. In: W. S. Hoar, D. J. Randall and J. R. Brett, editors. Academic Press, New York, USA. pp. 599-675.
[28]. Sakurai, A., Y. Sakamoto, and F. Mori. 1993. Aquarium Fish of the World : The Comprehensive Guide to 650 Species. Chronicle Books, San Francisco. 304 pp.
[29]. Sarkar UK, Lakra WS, Deepak PK, Negi RS, Paul SK, Srivastava A (2006). Performance of different types of diets on experimental larval rearing of endangered Chitala chitala (Hamilton) in recirculatory system. Aquaculture 261:141–150.
[30]. Shiri, H.A., Charlery, D., Auwerx, J., Vught, J., Slycken, J., Dhert, P. and Sorgeloos, P., 2003. Larval rearing of burbot (Loto lota) using Brachionus calyciflorus rotifer as starter food. J. Appl. Icthyol. 19 (2), 84-87.
[31]. Soriano-Salazar, M. B. y Hernández-Ocampo, D. 2002. Tasa de crecimiento del pez ángel Pterophyllum scalare (Perciformes: Cichidae) en condiciones de laboratorio. Acta Universitaria. 12:28-33.