Larviculture of Milkfish (*Chanos chanos*) in Outdoor Tanks

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Abstract

In the past, larviculture of milkfish depended entirely on the use of rotifers and brine shrimp nauplii and rearing trials were done under roofed facilities. Since the dietary value of live food varies according to culture and feeding conditions, rotifers were enriched with SELCO, a lipid emulsion containing high levels of highly unsaturated fatty acids (HUFA) prior to feeding the larvae. Alternatively, a microbound larval feed (Nosan R-1) was given as a supplement to rotifers during the first two weeks of culture. Larval growth was enhanced and survival was significantly improved when rotifers were enriched or supplemented with these diets. All rearing trials were conducted in 5-10 tons concrete circular/rectangular outdoor tanks.

Verification runs on the use of HUFA-enriched rotifers to milkfish larvae were tried in two nearby private hatcheries. Results from mis collaborative work are presented.

Introduction

Considerable progress in the development of hatchery techniques for milkfish had been achieved as a result of the spontaneous spawning of broodfish reared in floating net cages at Igang Marine Substation (Marte and Lacanilao 1986) and those reared in concrete tanks at Tigbauan Research Station (Emata and Marte 1990) of the SEAFDEC Aquaculture Department (SEAFDEC/AQD). These hatchery techniques were conducted under roofed facilities. Extensive larval rearing in outdoor ponds done in Taiwan (Lin 1985) simplified the artificial seed production of milkfish but water and feeding management schemes were not described. To encourage prawn hatchery operators in the Philippines to adopt this milkfish hatchery technology, larviculture has to be done using their existing rearing facilities which in most cases consist of large outdoor culture tanks.

Successful rearing of milkfish larvae at SEAFDEC/AQD depends entirely on the use of live food mainly rotifers and brine shrimps (Liao et al. 1979, Juario and Duray 1982, Juario et al. 1984, Gapasin and Marte 1990). However, the dietary value of rotifers and brine shrimps especially their ω3 highly unsaturated fatty acid

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(HUFA) content vary depending on culture and feeding conditions (Watanabe et al. 1983). Dietary enrichment of rotifers and brine shrimp with high HUFA levels have been reported to improve growth, survival, and success of metamorphosis of the cultured fish (Koven et al. 1990, Sorgeloos et al. 1991). This technique has yet to be tried on milkfish larvae.

In small-scale rearing experiments, supplementation of rotifers with microbound larval feed (Nosan R-1) during the first 14 days of culture enhanced growth and survival of milkfish larvae (Marte and Duray 1991). Verification of this result need to be demonstrated in large-scale hatcheries to determine its economic viability.

This paper describes larviculture of milkfish in large outdoor hatchery tanks at SEAFDEC/AQD and in two nearby private hatcheries in 1991 and 1992.

Methodology

Incubation

Naturally spawned eggs were transported to the hatchery and were incubated in 400-1 circular fiberglass tanks at 250-300 eggs/1. Each tank was provided with moderately aerated filtered seawater of ambient temperature and salinity. Dead eggs were siphoned out and water was partially changed by allowing the water to flow through. Larval density was estimated after hatching from 3-5 aliquot samples taken from the incubation tanks.

In the absence of incubation tanks in the private hatcheries, eggs were directly stocked into the larval tank (10 tons volume) at >50 eggs/1. Total number of eggs incubated was determined from 3-5 aliquot samples. Following hatching, the total number of hatched larvae was also determined from 3-5 aliquot samples.

Larval Rearing

Newly-hatched larvae (day 0) were stocked in 5-ton rectangular concrete tanks at 30 larvae/1 (Juario and Duray, 1987). Throughout the runs, water temperature ranged from 25.6 to 31.0 °C; salinity from 32 to 35 ppt and dissolved oxygen 5.5 ppm. In the private hatcheries, stocking density which ranged from 5 to 72 larvae/1. depended on hatching rates of the incubated eggs. In some instances, day 1 larvae were transported from SEAFDEC/AQD to the private hatcheries where these were reared. The basic feeding regime consisted of *Chlorella,* rotifers and brine shrimp nauplii (Fig.1). In addition, microbound larval feed rotifers were enriched with SELCO (Artemia System, Ghent, Belgium) 12 h prior to feeding to the

larvae (Fig. 2). Verification runs in the two private hatcheries used SELCO-enriched rotifers. Growth and survival were determined on day 21. To simplify the discussion, larval rearing done in each tank is considered as one hatchery run.

All statistical analyses were done using SPSS/PC statistical computer package.

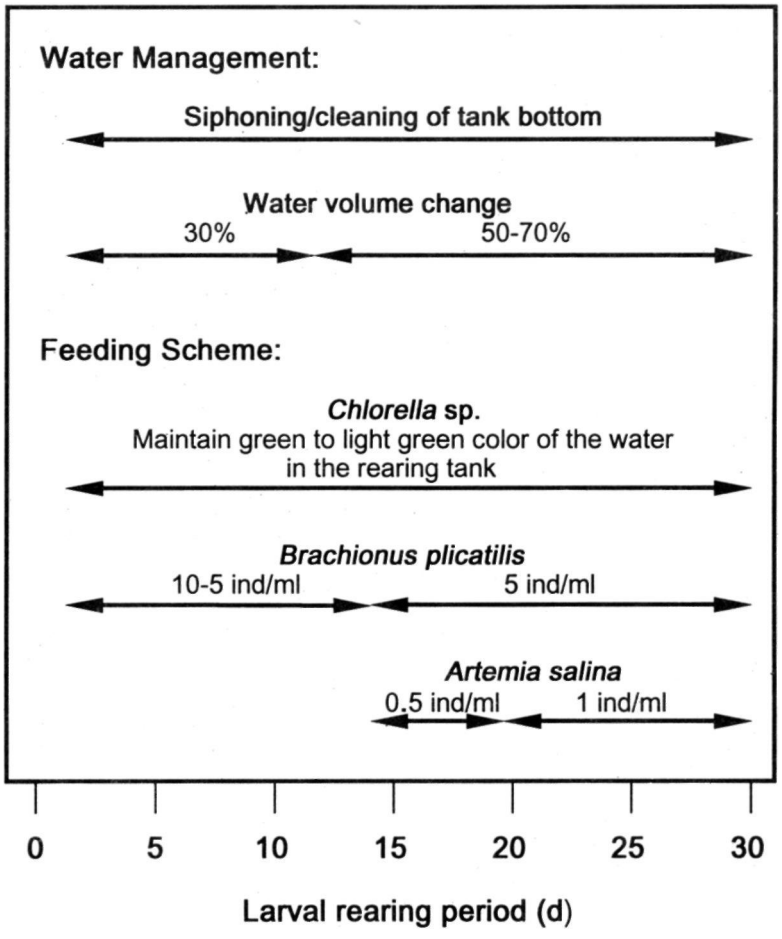

Fig 1. Water management and feeding scheme for rearing milkfish larvae (Juario & Duray 1987 in Marte, 1988).

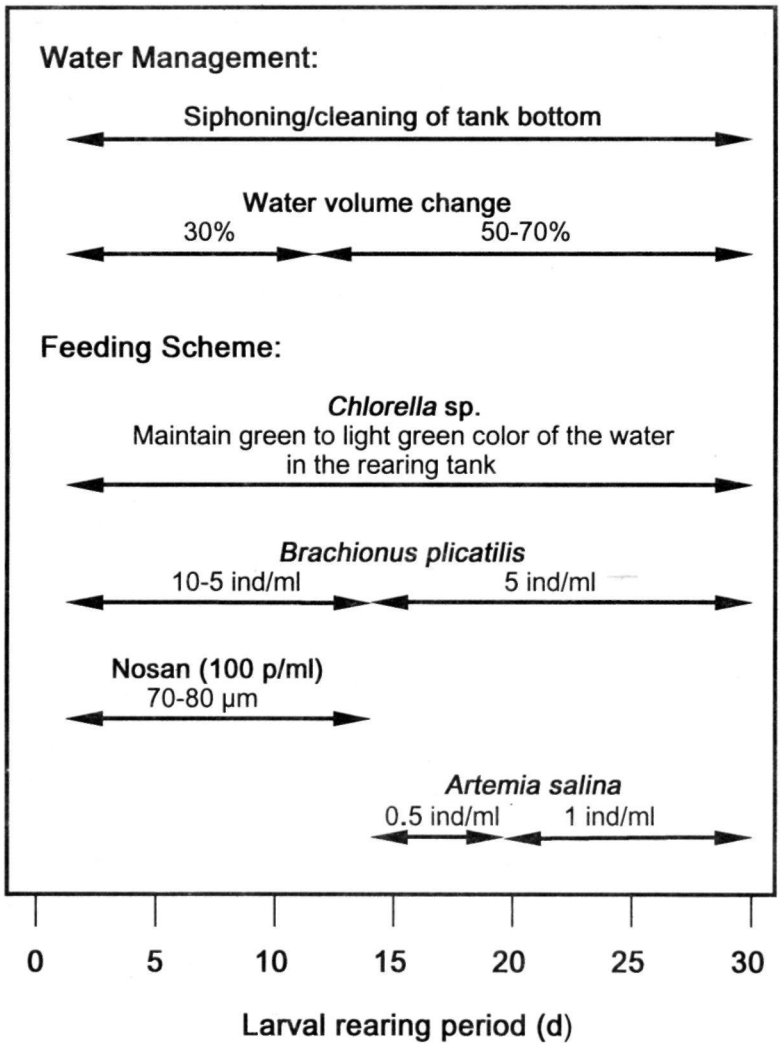

Fig 2. Modified water management and feeding scheme for rearing milkfish larvae (Juario & Duray 1987 in Marte 1988).(Nosan R-1, Nihon Nosan Kogyo, Japan) was given to day 2-14 larvae as supplement to rotifer, or

Results

Growth, survival rate and production of milkfish fry at SEAFDEC/AQD are shown in Table 1. Larvae reared on *Chlorella-fed* rotifers with or without supplementation of Nosan R-1 (N) did not differ significantly in length on day 21.

They ranged from 10.4-10.7 mm in total length. The survival rate of larvae in runs with Nosan supplement was higher (39.70%) than those without Nosan (11.70%). Harvest density of 16 fry/1 was produced using rotifers plus Nosan while only 4 fry/1 was harvested in runs without Nosan supplementation.

Table 1. Total length, survival rate and harvest density at day 21 of milkfish larvae reared on *Chlorella*-fed rotifers (CBA) or on rotifers with MBD supplement (CBNA). Means with the same superscript are not significantly different ($P<0.05$).

Treatments	Rearing runs	TL (mm)	Survival rate (%) (fry/1)	Harvest density (fry/1)
CBA	3	10.4 ± 0.2	11.7 ± 3.0[a]	4.3 ± 1.2[a]
CBNA	14	10.7 ± 0.9	39.7 ± 8.4[b]	15.6 ± 2.3[b]

Among the larvae fed SELCO-enriched rotifers, those that were subsequently fed brine shrimp nauplii (EBA) were relatively longer (12.9 mm) than those fed SELCO enriched rotifers alone (EB, 12.2 mm.) (Table 2). Those fed SELCO-enriched rotifers supplemented with Nosan R-1 and subsequently on brine shrimp nauplii (EBNA) were significantly shorter (11.6 mm).

Table 2. Total length, survival rate and harvest density at day 21 of milkfish larvae reared on SELCO-enriched rotifers alone (EB) or in combination with *Artemia* (EBA) and MBD (EBNA). Means with the same superscript are not significantly different.

Treatments	Rearing runs	TL (mm)	Survival rate (%) (fry/1)	Harvest density (fry/1)
EB	6	12.2 ± 0.5[ab]	32.7 ± 3.0[a]	8.8 ± 4.5[ab]
EBA	9	12.9 ± 0.7[b]	34.7 ± 3.2[a]	6.3 ± 2.3[a]
EBNA	3	11.6 ± 0.3[a]	39.8 ± 1.6[a]	9.2 ± 1.4[b]

Results from the rearing trials in the two private hatcheries are presented in Table 3. Except for day 1 transported larvae, the most of the survival rate attained were comparable with the data from SEAFDEC/AQD pilot milkfish hatchery.

Table 3. Survival rate of milkfish larvae reared for 21 days at ambient temperature (25.6-31.0 °C) and salinity (32-35 ppt).

Date	Estimated no. of eggs (million)	Estimated no. of larvae (million)	Actual no. of fry harvested (million)	Means % survival rate (range)
Hatchery I				
Apr '92	4.20	2.70	1.0	39.4 (25-52)
May-Jun '92	2.26	1.77	0.63	36.0 (32-52)
Jun '92	3.30	2.36	0.48	24.7 (15-37)*
Jul-Aug '92	4.63	3.18	1.17	34.7 (12-56)
Sept '92	2.85	2.67	0.76	29.0 (25-42)
Oct '92	2.0	1.44	0.53	46.0 (40-54)
Hatchery II				
Apr '91	0.45	0.204	0.083	31.6
May '91	0.30	0.160	0.015	9.4
	0.41	0.087	0.057	65.3
	0.39	0.176	0.085	48.3
Apr '92	**	0.173	0.041	23.0
	**	0.115	0.028	13.0
	0.23	0.124	0.025	20.0
May '92	**	0.120	0.028	22.0
	**	0.120	0.035	29.0
	0.45	0.178	0.066	37.0
	0.51	0.206	0.072	34.0
	0.51	0.280	0.104	37.0

*Heavy mortalities from day 15-19 due to destruction of seawater line due to typhoon.
** Day 1 larvae was transported to the private hatchery.

Discussion

Chlorella-fed rotifers given as sole food seemed nutritionally inadequate for rearing of milkfish larvae. This confirms the observations of Segner et al. (1984) although they used milkfish fry. Villegas et al. (1990) attributed this to low HUFA content (0.6% total n-3) of *Chlorella-fed* rotifers. Poor larval performance of gilthead seabream and European sea bass has also been attributed to low HUFA levels in rotifers and *Artemia* nauplii (Melloti et al. 1991).

Slight improvement on growth but significant increase in survival of milkfish larvae is attained by supplementation or enrichment of rotifers. Average growth of larvae fed enriched diet in this study are better than those reported by Eda et al. (1990) although slightly lower than those reported by Liao et al. (1979) and Juario et al. (1984). Mixed algal species were used by the latter studies. Eda et al. (1990) partly attributed the lower growth rates in their study to crowding although they used about 21 larvae/1. Most rearing trials in the present study used 30 larvae/1 as initial stocking density. Sorgeloos et al. (1988) and Kjorsvik et al. (1991) had similar improved results on other marine fish larvae using SELCO-enriched rotifers and *Artemia.* Inspite of this improvement in larval growth through enrichment of rotifers it is necessary to identify the nutrient requirements and how these can be manipulated for better growth enhancement.

The improved growth and survival of milkfish larvae fed with Nosan R-1 as supplement to rotifers in the present study verifies the results of Marte and Duray (1991) in small-scale rearing (200-1 tanks) experiments. The authors attributed this to the high HUFA content of Nosan R-1 (total n-3=6.75%; total n-6=18.68%). Larvae fed Nosan R-1 alone do not survive beyond day 15 indicating that they are unable to utilize the diet (Marte and Duray 1991). Although larvae ingested Nosan R-1 particles, the nutrients may have been obtained through the rotifers which were observed to ingest these feed. Ferraris et al. (1987) found esterase and alkaline phosphatase activities in milkfish enterocytes starting day 3 but not aminopeptidase activity. The lack of this and other digestive enzymes hinders the direct utilization of artificial feeds by young larvae. Similar observations were reported by Walford and Lam (1987) on tropical sea bass and by Tandler and Kolkovski (1991) on gilthead sea bream. Artificial feed supplements such as Nosan R-1 may prove to be more practical since it eliminates prior incubation of rotifers at high densities with lipid emulsion which require subsequent washing leading to mortalities of rotifers (Marte and Duray 1991). Other disadvantages of using lipid emulsion exposed to high temperatures have been pointed out by Walford and Lam (1987).

The survival rates achieved in the present study are within the range reported previously (Liao et al. 1979, Juario et al. 1984, Lin 1985, Eda et al. 1990.) A cost-and-return analysis of milkfish fry production of two private hatcheries showed that

the operation is economically viable (Garcia et al. submitted). Survival rate may be further improved by using S (smaller-sized) type rotifers (Eda et al. 1990) and is worth looking into in the future.

The present results verify on pilot and commercial scales earlier data obtained from small scale experiments that supplementation of Nosan R-1 to rotifers or enrichment of rotifers with high HUFA-booster diet significantly improved the survival of milkfish larvae. Comparable or better growth rates of larvae were also obtained with this feeding scheme than in larvae reared by conventional methods.

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