# Growth, Survival Rate and Production Cost of Juvenile Milkfish (*Chanos chanos*, Forskal) Culture with Three Different Live Feeds

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## ABSTRACT

Milkfish (*Chanos chanos*, Forskal) juveniles were fed with different feeds namely water flea, *Artemia* flake and *Artemia* nauplii in fiber glass tanks at densities of 50 fish/tank or 0.5 fish/liter for 60 days. Average initial length and weight of fry were 25.00±0.70 mm and 0.18±0.01 g, respectively. After 60 day nursing trials, growth parameters of milkfish by fed with water flea and *Artemia* nauplii were not significantly different (P>0.05) i.e. average lengths (46.02±2.90 and 46.40±5.97 mm, respectively), average weights (1.45±0.37 and 1.36±0.19g, resp.), ADG-length (0.35±0.05 and 0.35± 0.10 mm/day, resp.), ADG weight (0.021±0.06 and 0.019±0.003 g/day, resp.), SGR length (1.01±0.11 and 1.02±0.20 %/day, resp.), and SGR weight (3.41±0.48 and 3.34±0.24 %/day, resp). These figures were significantly higher (P<0.05) than those obtained from milkfish fry fed with *Artemia* flakes. The same trend is exhibited in survival rates, at 76.66±5.03 and 82.00±5.29 % for those fed with water flea & *Artemia* nauplii, respectively. These rates are significantly higher than that of fry fed with *Artemia* flakes (61.33±9.86 %).

The cost of milkfish juvenile production was 0.44, 1.53 and 5.54 Baht/fish with water flea, *Artemia* flake and *Artemia* nauplii as feed, respectively. This study recommend that water flea can be used as an economical feed for milkfish juveniles production.

**Key words:** milkfish, *Chanos chanos*, growth, survival rate

## INTRODUCTION

Milkfish (*Chanos chanos*, Forskal) is an economically important brackish water fish species cultured in Southeast Asia. Annual total production from the Philippines, Indonesia and Taiwan has been exceeding 300,000 metric tons since 1980. Wild-caught milkfish fry has been the only source for farming until hatchery fry became available in 1987 (Lee *et al*., 1997). In 1999 the total world production of cultured milkfish was estimated at 381,930 metric tons. To meet the production target with less available land for farming, traditional culture is practiced in shallow-water ponds which relied on wild -caught fry from coastal waters (Mao-Sen Su *et al*., 2002). The first found milkfish in Thailand was at Tambol Klongwan, Prachuabkirikan Province (Sonthirat and

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Dethae. 1982), where there used to have an active milkfish nursing in the past, but with lower production than other economic fish species. Milkfish nursing was not successful in Thailand, due to many factors, one of which is the feeding conditions which directly affects growth and survival rate.

The success in milkfish culture as food fish species may be attributed to its ability to tolerate extremes in environmental conditions (Villalus, 1984). Juveniles from natural habitats commonly feed on phytoplankton, lumut, algae, copepods and nematodes. Development of milkfish juveniles are longer for those fed with primarily more plant than animal food (Kumagai and Bagarinao, 1981). In the hatchery, larvae are normally fed with mixed diets of rotifer and *Artemia* nauplii. However, they may be weaned from live food to artificial diets (Duray and Bagarinao, 1984). Gapasin *et al*., (1998) reported that milkfish larvae fed with rotifer and *Artemia* nauplii enriched with HUFA (32-48 mg dry weight) or HUFA+vitamin C (33-45 mg dry weight) exhibited significantly ($P<0.05$) higher growth than those given unenriched live food. Although hatchery production of milkfish is now a commercially viable enterprise, research is being pursued to improve fry quality through feed supplementation and to lower production cost by using alternative live or artificial feeds (Marte, 2003). The objectives of this experiment were to study growth rate, survival rate and cost of production using different types of food to find the method to produce high quality fish with low production cost.

## MATERIALS AND METHODS

### Experimental design

Milkfish juveniles were fed with different feeds in fiber tanks at densities of 50 fish/tank or 0.5 fish/liter. The three treatments (with three replications) were feeding with water flea (*Moina* sp.), *Artemia* flake and *Artemia* nauplii (control) at 20 % of body weight per day, twice a day at 9 AM. and 3 PM. for 60 days: Diet quality based on nutrient content shown in Table 1. At the end of the experiment, remaining fish were counted to assess survival rate (SV), average daily growth (ADG), specific growth rate (SGR) according to Brown (1957), and the cost of production.

Table 1 Proximate nutrient composition of experimental diets

| Treatment | Diets | % dry matter | | | |
|---|---|---|---|---|---|
| | | Protein | Fat | Carbohydrate | Ash |
| 1 | Water flea* | 56.0 | 16.7 | 0.7 | 22.3 |
| 2 | *Artemia* flake | > 55.0 | > 5.0 | < 9.4 | < 5.0 |
| 3 (Control) | *Artemia* nauplii* | 52.2 | 18.9 | 14.8 | 9.7 |

Note : * Leger et al (1986) and Song (1994).

### Management of water quality

During the experimental period, 30 % of water was exchanged two times a week. The following parameters were analyzed: salinity, pH, temperature, dissolved oxygen, total ammonia, nitrite and alkalinity. Salinity was measured by Refractometer Prima tech. pH was measured by pH meter CyberScan pH 11. Temperature and dissolved oxygen concentration were measured by oxygen meter YSI 550A. Total ammonia was determined by Koroleff's Indophenol blue method (Grasshoff, 1976), while Nitrite was determined by Colorimetric method and alkalinity by titration method (APHA *et al.*, 2000).

### Statistical analysis

The experiments were conducted using a completely randomized design (CRD). Data were analyzed using Analysis of variance (ANOVA) and the difference between means was tested using Duncan's new multiple range test (DMRT) at 95 % level of confidence.

## RESULTS AND DISCUSSION

### Growth

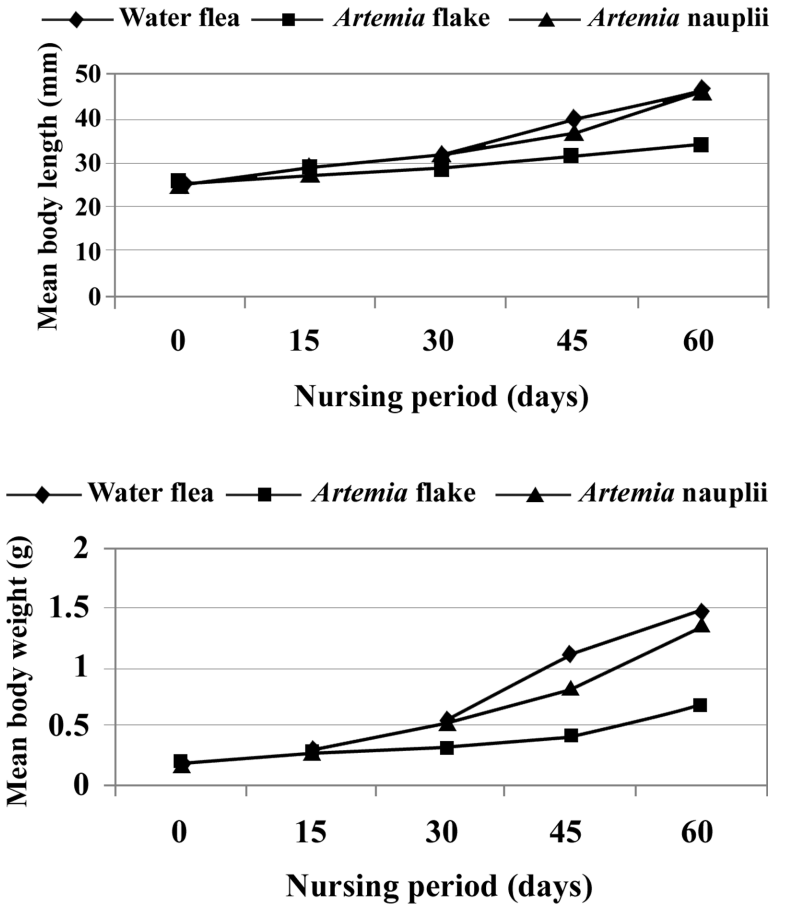
Results showed that at 15 days feeding the average lengths and weights of fish from all feeding groups were not significant different ($P>0.05$). But at 30 days feeding milkfish juveniles fed with water flea and *Artemia* nauplii had higher average weights than those fed with *Artemia* flake ($P<0.05$). At 45 and 60 days, both average lengths and average weights of milkfish juveniles fed with water flea and *Artemia* nauplii were not significantly different ($P>0.05$), and they were higher than those fed with *Artemia* flake ($P<0.05$). (Table 2, Figure 1)

Table 2 Average length and weight of milkfish fed with different feeds. (Mean±SD)

| Nursing periods (day) | Diets | | | | | |
|---|---|---|---|---|---|---|
| | Water flea | | *Artemia* flake | | *Artemia* nauplii | |
| | Length (mm) | Weight (g) | Length (mm) | Weight (g) | Length (mm) | Weight (g) |
| Initial | 25.00±0.70 | 0.18±0.01 | 25.00±0.70 | 0.18±0.01 | 25.00±0.70 | 0.18±0.01 |
| 15 | 27.83±1.95 | 0.29±0.04 | 28.53±0.50 | 0.28±0.02 | 27.23±1.02 | 0.26±0.05 |
| 30 | 31.23±2.35 | 0.51±0.08$^{a}$ | 28.70±0.95 | 0.31±0.02$^{b}$ | 32.30±1.15 | 0.52±0.09$^{a}$ |
| 45 | 39.60±3.31$^{a}$ | 1.08±0.28$^{a}$ | 31.70±0.70$^{b}$ | 0.39±0.02$^{b}$ | 37.06±0.97$^{a}$ | 0.81±0.07$^{a}$ |
| 60 | 46.02±2.90$^{a}$ | 1.45±0.37$^{a}$ | 34.20±3.01$^{b}$ | 0.65±0.24$^{b}$ | 46.40±5.97$^{a}$ | 1.36±0.19$^{a}$ |

Note : Means within the same row with different superscripts are significantly different ($P<0.05$)

Figure 1 Growth curve in average length (mm.) and weight (g) of milkfish fed with different feeds.




After 60 days of feeding when the experiment was terminated the average daily growth (ADG) in terms of length were not significantly different between juveniles fed with water flea & *Artemia* nauplii (0.35±0.10 mm/day) and it was higher than those fed with *Artemia* flake (0.15±0.05 mm/day) (Table 3). A similar trend is seen with ADG for weight and SGR for weight and length (Table 3). The statistical test showed that the average daily growth and the specific growth rate of milkfish juvenile fed with water flea and *Artemia* nauplii were not significantly different ($P>0.05$), and both groups had better growth than those fed with *Artemia* flake ($P<0.05$).

**Survival rate**

The same trend is followed by the survival rates. Survival rate of milkfish juveniles fed *Artemia* flake (61.33%) was significantly lower ($P<0.05$), while those fed with *Artemia* nauplii was the highest (82.00%). However, survival rate of milkfish juveniles fed with water flea (76.66%) and *Artemia* nauplii (82.00%) were not significantly different ($P>0.05$) (Table 3).

Table 3 Average growth and survival rate of milkfish fed with different feeds. (Mean±SD)

| Parameters | Diets | | |
|---|---|---|---|
| | Water flea | *Artemia* flake | *Artemia* nauplii |
| **Initial average length (mm)** | 25.00±0.70 | 25.00±0.70 | 25.00±0.70 |
| **Initial average weight (g)** | 0.18±0.01 | 0.18±0.01 | 0.18±0.01 |
| **Final length gain (mm)** | 46.02±2.90$^{a}$ | 34.20±3.01$^{b}$ | 46.40±5.97$^{a}$ |
| **Final weight gain (g)** | 1.45±0.37$^{a}$ | 0.65±0.24$^{b}$ | 1.36±0.19$^{a}$ |
| **ADG of length (mm/day)** | 0.35±0.05$^{a}$ | 0.15±0.05$^{b}$ | 0.35±0.10$^{a}$ |
| **ADG of weight (g/day)** | 0.021±0.006$^{a}$ | 0.007±0.003$^{b}$ | 0.019±0.003$^{a}$ |
| **SGR of length (%/day)** | 1.01±0.11$^{a}$ | 0.52±0.15$^{b}$ | 1.02±0.20$^{a}$ |
| **SGR of weight (%/day)** | 3.41±0.48$^{a}$ | 2.04±0.73$^{b}$ | 3.34±0.24$^{a}$ |
| **Survival rate (%)** | 76.66±5.03$^{a}$ | 61.33±9.86$^{b}$ | 82.00±5.29$^{a}$ |

Note : Means in the same row with different superscripts are significantly different ($P$<0.05)

## Cost of Production

At the end of the experiment, the average total feed given was 246, 130.5 and 225 g for water flea, *Artemia* flake and *Artemia* nauplii, respectively, and the total costs were 17.22, 46.98 and 227.47 Baht, respectively. Therefore the unit costs of milkfish juvenile production fed with water flea, *Artemia* flake and *Artemia* nauplii was 0.44, 1.53 and 5.54 Baht/fish, respectively (Table 4).

Table 4 Cost of milkfish fed with different feeds in fiber tanks for 60 days. (Mean)

| Parameters | Diets | | |
|---|---|---|---|
| | Water flea | *Artemia* flake | *Artemia* nauplii |
| **Number of fish survival (fish)** | 38.3 | 30.6 | 41.0 |
| **Total feeds (g)** | 246 | 130.5 | 225 |
| **Total cost of feeds (Baht)** | 17.22 | 46.98 | 227.47 |
| **Cost per fingerling (Baht/fish)** | 0.44 | 1.53 | 5.54 |

Note: At experiment period, average cost of water flea was 70 Baht/kg, *Artemia* flake was 360 Baht/kg and *Artemia* nauplii (cyst) was 1,011 Baht/kg.

### Water quality

The average reading of water quality in each treatment were not significantly different ($P$>0.05) and did not affect growth and survival rate of milkfish juveniles (Almendras, 1987; Cruz, 1981). (Table 5)

Table 5 Water quality in fiber tanks for nursing milkfish with different feeds for 60 days (Mean±SD)

| Parameters | Diets | | |
|---|---|---|---|
| | Water flea | *Artemia* flake | *Artemia* nauplii |
| **Salinity (ppt)** | 30 | 30 | 30 |
| **Temperature ($^0$C)** | 27.6±0.69 | 27.4±0.67 | 27.4±0.62 |
| **Dissolved oxygen (mg/l)** | 7.84±0.06 | 7.63±0.11 | 7.94±0.17 |
| **pH** | 8.39±0.07 | 8.32±0.06 | 8.40±0.05 |
| **Alkalinity (mg/l as $CaCO_3$)** | 136.0±1.00 | 141.0±10.44 | 135.0±1.00 |
| **Total ammonia (mg/l)** | 0.010±0.00 | 0.058±0.03 | 0.008±0.001 |
| **Nitrite (mg/l)** | 0.358±0.166 | 0.374±0.08 | 0.341±0.088 |

## CONCLUSION

This experiment showed that the average daily growth, the specific growth rate and the survival rate of milkfish nursed with water flea and *Artemia* nauplii were not significantly different ($P$>0.05) and had significant better growth and survival rates than those fed with *Artemia* flake ($P$<0.05). However, the best feed was not only decided by good growth or high survival. Production cost has to be considered as well. The high cost of production is mainly due to the increasing price of *Artemia* cyst, thus water flea, a live food, is widely used for nursing fresh water species. The selling price of water flea is about 60-80 baht/kg which is much cheaper than *Artemia* cyst (Kanthom *et al*., 2000). Therefore, water flea can be used to substitute or replace *Artemia* to nurse milkfish fry to lower production cost and earn higher profit. *Artemia* flake gave slower growth and poor survival rate during this experiment. The main reason may come from less feed consumption of the fry, because the flakes would quickly sinks to the bottom of the tank and the particle size is normally bigger than water flea and *Artemia* nauplii. This directly affected the growth and survival of fish as the feed was not available to the fry in this form. Particle size of feed and feeding frequency may be considered for future studies/researches.

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