

Growth Performance of Milkfish Fed Soy-Based Feed in Low Volume High Density Cages in Manjuyod Bay, Philippines

Results of ASA-IM/Soy-in-Aquaculture 2006 Feeding Demonstration Project

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ABSTRACT

A feeding demonstration was conducted at Manjuyod Bay, Negros Oriental, Philippines to demonstrate the growth of milkfish (*Chanos chanos*) grown in low volume, high density (LVHD) cages using an ASA-IM formulated 34% protein, 6% fat (34/6) soy-based, extruded feed. Milkfish fingerlings of about 28 g were stocked into three 27 m³ cages at 5,063 fish per cage. Fish in all cages were fed a soybean meal based, extruded feed (34/6) that was produced domestically in the Philippines. After 149 days of culture, fish reached an average size of 364 g with a gross average harvest of 1,758 kg/cage (65.1 kg/m³), an average survival of 95% and an average FCR of 1.86:1.

INTRODUCTION

The American Soybean Association International Marketing (ASA-IM), under the Soy-in-Aquaculture (SIA) Project and in cooperation with Resources Producer Technology Corporation (REPROTECH) of Manjuyod Bay, Negros Oriental, Philippines, conducted a 149-day feeding demonstration with milkfish in low volume, high density (LVHD) cages. The objectives of the project were to demonstrate the feasibility of culturing milkfish at a high density in small cages using the ASA LVHD cage technology, and to investigate the performance of a new soy-based aquafeed formulation.

MATERIALS AND METHODS

Three, 27-m³ (3 m x 3 m x 3 m) cages at the REPROTECH cage farm site in Manjuyod Bay, Negros Oriental, Philippines, were used for the demonstration. The cages were constructed with a welded steel floating frame from which a rectangular nylon mesh (mesh size varied by size of fish), double bag cage net was suspended and weighted down to maintain the cage shape against water currents. Each cage was equipped with an internal feed enclosure and a light blocking cover as specified in the ASA-IM LVHD Manual “Principles and Practices of High Density Fish Culture in Low Volume Cages”. The three demonstration cages were placed at the outside edge of the cage farm and spaced to provide at least one cage length of open water on all sides of each cage to facilitate water exchange. Cage nets were replaced on a 10- to 15-day cycle to combat bio-fouling.

Milkfish fingerlings of about 12 g were obtained from local land-based hatchery ponds and grown in cages to about 28 g average size for the demonstration. Milkfish were stocked in the 27-m³ LVHD demonstration cages at a density of 5,063 fish per cage. Fish in all three cages were of uniform size and age at stocking. Milkfish production targets were 400 g per fish and 2,025 kg per cage for the LVHD cages, or 75 kg/m³ of cage volume.

Milkfish in all cages were fed twice daily, and as size increased, three times daily, with extruded, floating, pelleted feeds formulated to contain 34% crude protein and 6% crude lipid (34/6). This feed was least-cost formulated by ASA-IM, and contained, depending on the feed manufacturer and ingredient cost, approximately 40% soybean meal by volume as a percentage of total feed ingredients. The feed was produced domestically in the Philippines by Feedmill A (Tables 1-3). The three demonstration cages were treated as replicates of a single feed treatment, with fish in all cages fed the same amount at the same time using the ASA satiation feeding technique.

Cage management was based on the ASA-IM cage production model. Fish in all cages were visually observed once per month on about the same date each month by an ASA-IM SIA project member to determine growth. According to agreed protocol, no physical sampling of the fish took place to reduce potential stress from sampling. At the conclusion of the project, all cages were completely harvested and all fish weighed. All of the harvested fish were enumerated when weighed to obtain an average fish size and fish survival. Results were used to determine fish survival, average fish weight, gross fish production and feed conversion ratio (FCR).

RESULTS

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Milkfish were cultured a total of 149 days between April 18 and September 15, 2006. Milkfish in all cages grew from an average of 28 g to 364 g in this period (Figure 1; Table 4). Gross production averaged 1,758 kg (65.1 kg/m³ of cage volume) and average survival rate was 95% (Table 4). Average FCR was 1.86:1 (Figure 2; Table 4).

SUMMARY AND CONCLUSIONS

This demonstration again showed the feasibility of producing milkfish at higher densities than are normally used in the Philippines, in smaller cages that are less costly and easier to manage. Construction costs were lower for the smaller cages and the cages took up less space than the larger cages, an important aspect for Manjuyod Bay which is regulated by the local government for maximal surface area use.

The principal goal of testing a new feed formulation with the milkfish may have been compromised by incorrect feeding techniques used in the initial 5-6 week culture period, where fish were offered $\leq 50\%$ of their satiation level on the first day of a 10 day feeding cycle. This led to fish that initially grew very poorly, with abnormally low FCRs. Fish also became behaviorally conditioned to seeking food outside the feed enclosure, a situation that continued for some time after the feeding technique issue was resolved. Fish took longer to grow to target size, and in addition there were concerns about the color of the fish (the fish looked grayish instead of the normal black – this is an issue for marketability) and the “density” of the fish, that visually appeared about 15% heavier than they actually were (only visual sampling was performed for this project). It is difficult to determine how much of these color and weight problems have to do with the initial underfeeding, but the slower growth was certainly caused by the initial improper feeding.

Soy-based feeds have been shown to be economically advantageous to milkfish farmers in the Philippines. Further testing of soy-based rations in field trials are needed to better quantify milkfish growth and feed efficiency on this type of diet, and to determine if further modifications to the diet are needed. Based on the results of this year, a new location will be chosen for 2007 and modifications made to the diet to address the fish color and density issues.

ACKNOWLEDGEMENTS

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Growth Curve of Milkfish in LVHD cages in Manjuyod Bay, Negros Oriental, Philippines.

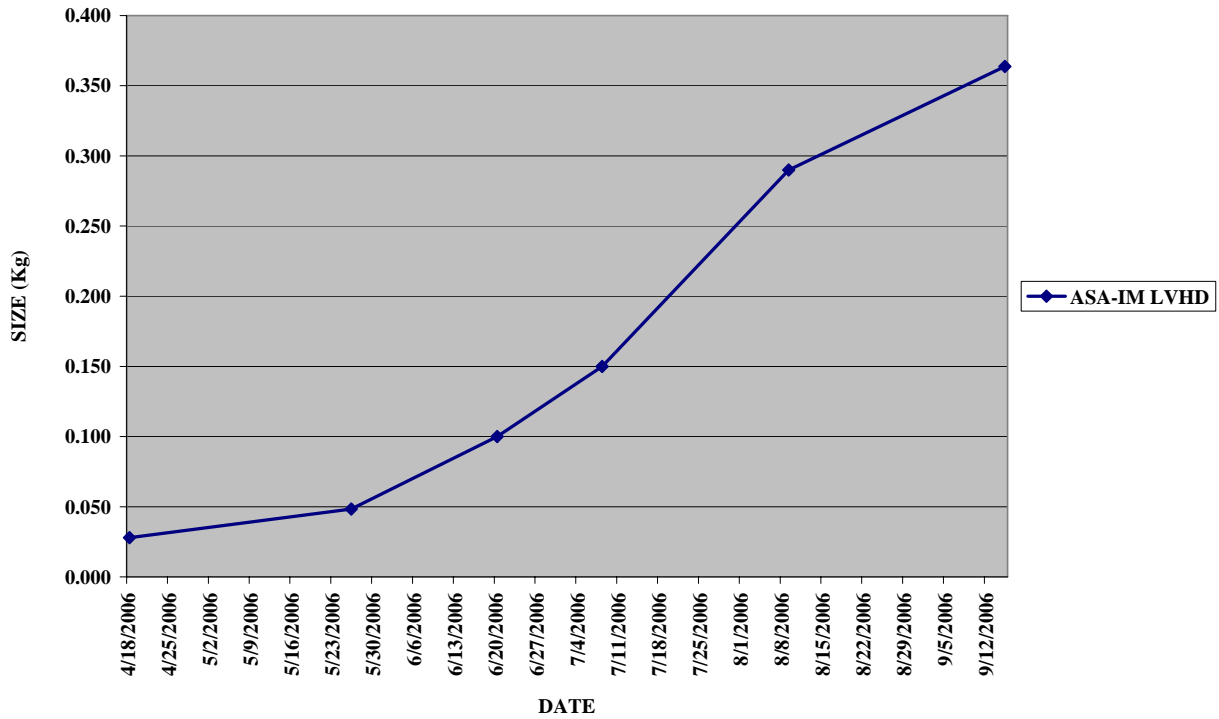


FIGURE 1. Growth curve for milkfish in LVHD cages over a 149-day culture period in the 2006 ASA-IM SIA Milkfish Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines. Milkfish grew from 28 g to 364 g in the 27-m³ LVHD cages during this period.

FCR of Milkfish in LVHD cages in Manjuyod Bay, Negros Oriental, Philippines.

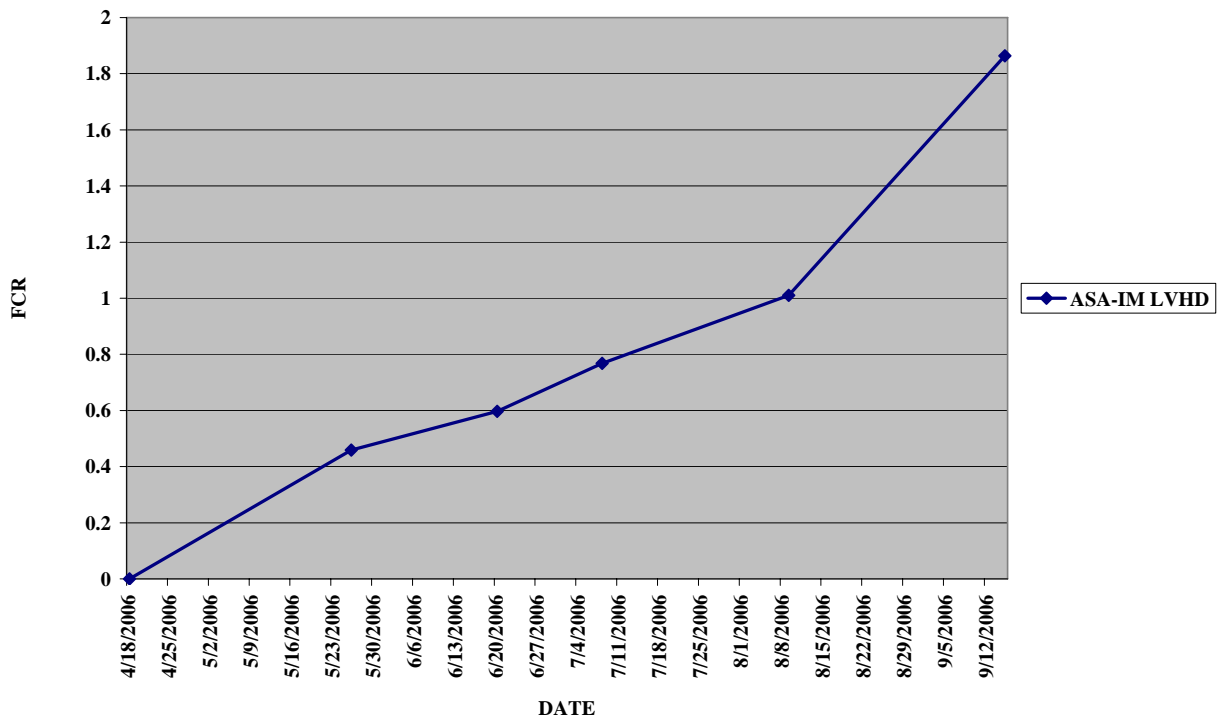


FIGURE 2. FCR curve for milkfish in 27-m³ LVHD cages in the 2006 ASA-IM SIA Milkfish Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines. Average FCR during the 149-day culture period was 1.86:1.

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TABLE 1. First formula provided to Feedmill A for the ASA 34/6, soymeal-based feed used in the 2006 ASA-IM SIA Milkfish Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines. The feed was fed in 3-4 mm, extruded pellet form.

**34/6 ASA-IM Feed
2006 Philippine Milkfish Feeding Demonstration**

Ingredient	% Inclusion Rate
Soybean Meal - 47%	40.00
Wheat, ground grain	22.80
Fishmeal, whole 63.7/8	15.50
Cassava Meal	10.00
Fish Oil	3.75
Poultry BP-69	3.50
Ca phosphate 18.7%P	3.50
Vitamin Premix F2	0.50
Mineral Premix F1	0.25
Choline Chloride (liquid)	0.09
Mold Inhibitor	0.05
Antioxidant	0.03
Stay C - 35%	0.03
TOTAL	100.00

¹The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 34/6 indicates 34% crude protein and 6% crude fat.

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TABLE 2. Second formula provided to Feedmill A for the ASA 34/6, soymeal-based feed used in the 2006 ASA-IM SIA Milkfish Comparative Project at Manjuyod Bay, Negros Oriental, Philippines. The feed was fed in a 4-mm extruded pellet size.

34/6 ASA-IM Feed 2006 Philippine Milkfish Feeding Demonstrations

Ingredient	% Inclusion Rate
Soybean Meal - 47%	40.00
Wheat, ground grain	22.20
Fishmeal, whole 63.7/8	19.50
Cassava Meal	10.00
Fish Oil	3.90
Ca phosphate 18.7%P	3.45
Vitamin Premix F2	0.50
Mineral Premix F1	0.25
Choline Chloride (liquid)	0.09
Mold Inhibitor	0.05
Antioxidant	0.03
Stay C - 35%	0.03
TOTAL	100.00

¹The numerical component of the feed description refers to the percentage of protein and fat, respectively, in the ration, i.e. 34/6 indicates 34% crude protein and 6% crude fat.

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TABLE 3. Vitamin and mineral premix formulas produced by Progressive Laboratories and provided to Feedmill A for the ASA-IM 34/6 soymeal-based feed used in the 2006 ASA-IM SIA Milkfish Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines.

Vitamin Premix PMX-F2¹

Nutrient	Unit	As fed
Vitamin A	IU/kg	1200000
Vitamin D3	IU/kg	200000
Vitamin E	IU/kg	20000
Biotin	mg/kg	40
Folic acid	mg/kg	1800
Niacin	mg/kg	40000
Pantothenate	mg/kg	20000
Pyridoxine (B6)	mg/kg	5000
Riboflavin (B2)	mg/kg	8000
Thiamin (B1)	mg/kg	8000
Vitamin B12	mcg/kg	2000
Ethoxyquin	mg/kg	500

Mineral Premix PMX-F1¹

Nutrient	Unit	As fed
Iron	ppm	40000
Manganese	ppm	10000
Copper	ppm	4000
Zinc	ppm	40000
Iodine	ppm	1800
Cobalt	ppm	20
Selenium	ppm	200

¹Premix ingredient quantities are per kg of premix.

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TABLE 4. Results of the 2006 ASA-IM SIA Milkfish Comparative Demonstration Project at Manjuyod Bay, Negros Oriental, Philippines that demonstrated growth performance of milkfish using the ASA-IM LVHD production model and a soymeal-based, least-cost formulated 34/6 feed.

Cage No.	Treatment	Stocking size (g)	Stocking rate (fish/cage)	No. days cultured	Harvest weight (g) ¹	Gross Production		Survival (%)	FCR
						(kg/cage)	(kg/m ³)		
X-4	LVHD	26	5063	149	377	1726	63.9	90	1.88:1
X-5	LVHD	30	5063	149	352	1766	65.4	98	1.85:1
X-6	LVHD	28	5063	150	362	1782	66.0	97	1.87:1
	Mean	28	5063	149	364	1758	65.1	95	1.86:1

¹ This average weight is taken from the fish considered to be stocked and not wild fish that entered the cage from the wild at a later date (termed “fingerlings” by the farmer).