Production of Rabbitfish (*Siganus guttatus)* in Cages Fed With Commercial and Experimental Diets: An Environment –Friendly Archetype

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Abstract

Rabbitfish (*Siganus guttatus*) with a mean weight of 24.43 grams were reared in an environment-friendly archetype floating cages for 90 days at a stocking density of 50 fish per cubic meter. Each cage has a total water volume of 1.5 cubic meter. The fish were fed with commercial (milkfish and Shrimp) and experimental diets. Highest growth was obtained in treatment 2(240.06 g mean body weight) with a total production of 53.6 kilos which was given shrimp feed. Lowest growth was obtained by treatment 1 (214.38 g mean body weight) with a total production of 46.5 kilos. Analysis of variance showed significant difference among treatments. Duncan's Multiple Range Test (DMRT) revealed that treatments 2,3 and 1 are significantly different from each other, while treatment 3 and 1 are significantly similar. Survival rates of all treatments were relatively high(96.44 % - 99.11%). The highest was obtained from treatment 2,followed by treatment 3 and treatment 1 respectively. However, no significant difference was found among treatments. Economic analysis showed that all treatments obtained viable Benefit Cost Ratio (BCR). Highest BCR was obtained by treatment 3 followed by treatment 1 d the lowest was treatment 2. Result of this study revealed that all treatments were feasible. Treatment 3 was the most efficient considering its high production and low production cost.

Regarding the environment-friendly and sustainability, this study featured technology applied to cage construction and feeding management aspects that ensures sustainability of the environment.

Introduction

The world population exceeds six billion and is still growing. Obviously food security Becomes a question. How to feed the growing population when ocean catches seem to have reached their limit. The catch from the commercial fishing is declining to about one third (1/3). Collapsing fisheries will hurt about a billion people, especially in Southeast Asia (Surtida, 2000). In the Philippines, filipinos may be faced with some grim problems for the millenium that is if efforts of sustainable fishery industry are not done. Given a steady 2.1 % annual population increase, a fish deficit of 600,000 tons for this year will rise to about a million by year 2004. With fishing in coastal waters at a decline, the country will have to increasingly depend on aquaculture (Dagoon,1999). In the attainment of increased fish production, improved aquaculture systems and techniques for cultivation of other aquaculture species must be developed. All these aquaculture practices to be developed must be environment- friendly in order to attain sustainability.

One of the recommended aquaculture species is the rabbitfish. Siganid (rabbitfish) locally known as *samaral ,maalaga, dangit, and balabis* are potential for farming (Ablan and Rosario, 1981, Ben-Tuvia, *et al*, 1973). Of the 17 species of siganis in the Philippines, *Siganus guttatus* was chosen to be suitable for pond culture and mariculture because of its biological characteristics as fast growing, large size, hardiness and tolerance to crowding.(Alcala,1979), Gerochi, *et al*, 1988). This species commands a high price in the local and international markets; is also a popular for fish throughout the Philippines because of its flaky white tasty flesh and a good source of protein in our diet.

In the cultivation of any species, its feeding must be considered because 60 – 70 % of the production cost is derived from feeds. Siganids have been studied by several researchers and were cultured in ponds, pens and cages. However, much remains to be investigated in terms of feeding. In the grow-out culture, studies have been conducted using algae and other plant sources (Carumbana,1983m Westernhagen, 1974); others used bangus commercial feeds (Destajo, 1999, unpublished, Roa, 1999, unpublished); others still used the combination of commercial feeds and *lumot* (Gomez, 1986, Toledo, 1992). These researchers recommended different protein levels. The aforestated studies, the use of formulated feed specifically for *Siganus guttatus* has not been made. Moreover, until this time there is no specific feeds for *Siganus guttatus* and other *Siganus* species. Tacon (1999) tried the use of in-house formulated feeds for *Siganus canaliculatus* and he recommended that feeds with 35 % protein will result to faster growth.

The objectives of this study therefore were the following: 1. Determine the effect of commercial and experimental diets on the growth and survival of *Siganus guttatus.* 2. Determine the economic viability of using the commercial and experimental diets.

Materials and Methods. Nine environment-friendly designed cages measuring 1m X 1m X 2m each were use as experimental Units which were installed in an anchored bamboo raft at an equal distance of 50 centimeters each. Each cage ha a water volume of 1.5 cubic meter with a free board of 50 centimeters.

Experimental Design and analysis. The experiment consisted of 3 treatments with 3 replicates following the Complete Randomized Design (CRD). The data collected was analyzed using the Analysis of Variance (ANOVA). Significant differences were identified using the Duncan'' Multiple Range Test (DMRT).

Fish Stocking and Sampling. *Siganus guttatus* fry use in this study were conditioned to its culture environment until it reach the size enough for the mesh of the cage. They were stocked in one *hapa* net for two months. Finally the test fish with a mean weight of 24.43 grams were stocked in the experimental cages at a stocking density of 50 fishes per cubic meter or a total of 75 fishes per cage. Sampling was done randomly and was conducted every 30 culture days. Ten samples were taken from each cage. After taking the weight and length, the fish were immediately returned to their respective cages.

Experimental Feeds and Feeding. Feeds used in this study were the Milkfish starter crumble in the first month and milkfish grower in the succeeding months for treatment 1, Shrimp starter 1 for the first month and Shrimp grower for the succeeding months for treatment 2.. Home made experimental diet for treatment 3. Table 1 and 2, shows the formulation and proximate analysis of experimental diets(Tacon,1999) and the crude protein content of the commercial feeds.

Feeds were given three time daily in an environment-friendly practice. Feeding was scheduled at 7:00 a.m., 12:00 noon, and at 5:00 p.m. Feeding rate (Table 5) was based on the study of Roa (1999 unpublished).

RESULTS AND DISCUSSION

Periodic mean weight increment is shown in Figure 1. In the first 30 days of culture treatment 2 and treatment 1 has almost the same mean weight gain which was higher than treatment 3. The difference in the growth of fish in this period was affected b the size of the feeds. Treatments 1 and 2 used starter feed which were smaller which made easier for the fish to eat. Compared to the experimental feed which was larger hence, caused the smaller fish unable to eat.. On the 60th day growth result by treatment 3 almost leveled with those of treatment 1. And on the 90th day those of treatment 1 and 3 are already similar. Treatment 2, which was given shrimp feed obtained the consistent highest growth with a mean weight of 240.06 gram, followed by treatment 3 with a mean weight of 217.81 grams which was given experimental diets., and the lowest was treatment 1 with a mean eight of 214.38 grams, given milkfish feed. Analysis of Variance showed significant difference($p<0.05$)among treatments. Duncan's Multiple Range Test (DMRT) revealed that treatment2 was significantly different while treatment 3 and treatment 1 are significantly similar with each other. The protein content of the feeds affected the consistent highest growth obtained by treatment 2. Shrimp feed had the highest protein content among the three feeds, confirming Toledo's (1992) statement that formulated fees with higher protein content were significantly efficient.

Table 3 presents the summaries of survival, survival rate, food conversion ratio and food conversion efficiency after 90 days of culture. The survival rate of all treatments in this study was relatively high which range from 96.44 %– 99.11%. The highest was obtained from treatment 2, followed by treatment 3 and treatment 1 respectively. However, no significant difference was found among treatments. In terms of Food Conversion Ratio (FCR),treatments 2 and 3 had an FCR of 1.5 and treatment 1 had an FCR of 1.8. Analysis of Variance revealed no significant difference among treatments.

Production and Economic Analysis. Highest mean production was obtained by treatment 2(53.6 kls) or 18 kls. Per cage followed by treatment 3(48.4 kls) or 16 kls per cage., and the lowest was obtained by treatment 1(46.5) or 15kls percage. Simple cost analysis revealed that among the three treatments considering all the necessary materials and production cost, treatment 2 with the highest production had the most production cost. While treatment 3 with the 2nd highest production had the least production cost.(Table 4). The difference in the production cost per treatment was attributed to the cost per kilo of feeds. Profitwise, all treatment indicated feasibility as shown by their Benefit Cost Ratio. Treatment 1 had a BCR of 1.6 , treatment 2 ha d a BCR of 1/1 and treatment 3 1.9. Reyes (1984) stated that "A project with a BCR equal to or greater than 1 is acceptable or feasible. Economically, treatment 3 was most efficient and feasible considering its high production and low production cost.

Environment-Friendly and Sustainable Development. The worldwide phenomenon of fisheries depletion focused attention towards aquaculture in meeting the need of The world growing population. Aquaculture activities however, has been associated with serious negative environmental impacts. Sustainable development is defined by FAO (1991) and read at Dagoon (1998) as the management and conservation of the natural resource base, and the orientation of technology and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development conserves land, water, and plant and animal genetic resources. Is environmentally non-degradable, technically appropriate, economically viable and socially acceptable.. Realization of this definition can only be attained through an environment friendly aquaculture activities. This study an **environment – friendly archetype** operationalized the above definition. The cage construction with waste receptacle avoided degradation of the environment. Physical and chemical parameter of the water were monitored and observed at its normal condition favorable to life of all flora and fauna to maintain its ecological balance. The construction cost was at very minimal level making it very economically viable and socially acceptable by small scale fishfarmers. Its high production makes it technically appropriate to met the growing need of fish supply world wide.

Conclusions. Diet with high protein content(30-35%) ensures high growth and survival of *Siganus guttatus* in floating cages. Based on the this study milkfish feed and experimental diets resulted to higher Benefit Cost Ratio (BCR). Experimental diet was most efficient and economically profitable.

Recommendations. A study should be conducted using formulated diets using low cost protein source ingredients. The effect of formulated diets of different levels of protein on the growth and survival and economic viability of culturing *Siganus guttatus* must be investigated to determine the levels of protein for the cage culture of this species.

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Table 1. Formulation and proximate chemical composition of exptl diet. (Tacon, 1990)

Formulation %	**Gram/100g of feed**
Fish meal	22.00
Soybean meal	25.00
Rice bran	40.55
Wheat flour	10.00
Fish oil	2.00
Vitamin premix	0.20
salt	0.25
total	100.00
Proximate composition (% dry matter basis)	percentage
Crude protein (N X 6.25)	34.77
Crude lipid	10.39
Crude fiber	7.26
Ash	8.83
Salt	0.36
Calcium	0.97
Phosphorus	1.35
Nitrogen free extracts	38.55
Gross Energy K cal/100 g	483.1

Table 2. Proximate composition of commercial feeds

COMPOSITION	P E R C E N T A G E			
	Milkfish crumble	Milkfish grower	Shrimp Starter	Shrimp grower
Crude protein	34.0	29.0	40.0	37.0
Crude fat	6.0	5.0	4.0	4.0
Crude fiber	5.0	8.0	4.0	4.0
Crude ash	12.0	12.0	16.0	16.0
Moisture	12.0	12.0	12.0	12.0

Table 3. Summaries of survival, Survival Rate, production, FCR and FCE

Treatmments	Stocking density	Survival	Survival Rate %	Production kls	FCR	FCE %
Treatment 1	225	217	96.4	46.516	1.8	56.8
Treatment 2	225	223	99.11	53.564	1.5	71.42
Treatment 3	225	222	98.67	48.361	1.5	67
total	675	662		148.44 kls		

Table 4. Economic analysis of the production of *Siganus guttatus* in floating cages fed with commercial and experimental diets.

Particulars	Treatment 1	Treatment 2	Treatment 3
Construction cost/cage	1083.75	1083.75	1083.75
Operation Cost	670.50	1222.50	530.50
Depreciation per cage	180.625	180.625	180.625
Total Operation cost	850.125	1403.125	711.125
Production per cage	15.5	18	16
Pice per kilo	85	85	85
	1317.5	1530	1360
Net gain	467.38	126.88	648.88
BCR	1.6	1.1	1.9

Note. There are three operations per year and the structure will last for two years therefore the construction cost will be divided by 6 to get the depreciation cost.

Table 5. Feeding rate (Roa,1999)

ABW (g)	% TBW	ABW	%TBW
8	7.04	70	4.77
10	7.0	80	4.64
12	6.8	90	4.53
14	6.6	100	4.44
16	6.4	110	4.35
18	6.3	120	4.28
20	6.1	130	4.21
25	5.9	140	4.15
30	5.6	150	4.09
35	5.5	160	4.04
40	5.3	170	3.99
45	5.2	180	3.95
50	5.1	190	3.9
55	5.0	200	3.66
60	4.93	210	3.03
65	4.84		