



Golden Apple Snail as Source of Protein Diets of Fattened Mud Crab (*Scylla serrata* Forskal) in Cellular Bamboo Cages

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Received 5 March 2015 Accepted 31 May 2015 (*Corresponding author)

Abstract To identify feed alternative in the fattening of mud crab (*Scylla serrata* Forskal), three diets were tested using a modified cellular cages. Mixed sex crabs were fed with trash fish, golden apple snail and combination of trash fish and golden apple snail at 10% body weight. Growth, survival, moulting and picked meat yield and quality were evaluated. Specific growth rate and survival were highest in crabs fed with golden apple snail and combination. Moulting was significantly affected by diet types. There was no significant difference in the yield of picked meat and overall acceptability scores. Golden apple snail could be a potential dietary substitute for trash fish.

Keywords mudcrab fattening, specific growth rate, bamboo cages, feed types

INTRODUCTION

Mud crab (*Scylla serrata* Forskal) locally known as “alimango” is considered as the biggest, fastest growing and the most desirable aquaculture mud crab species in the country. For the past decades aquaculture of mud crab has been intensively studied because of the high market demand of the commodity and dwindling wild stocks. Hatchery technology was developed and adopted to answer the problem in seed supply which was considered as the major limitation of mud crab farming in its early stages (Keenan, 1999). Feeding management in grow out, perceived as the main bottleneck in the advancement of mud crab aquaculture, has been carefully studied through development of formulated diets and experimental feeding (Catacutan et al., 2003; Christensen et al., 2004). Research has demonstrated the high feasibility and profitability of this aquaculture endeavour.

According to Keenan (1999), there are two basic forms of mud crab aquaculture, fattening of crabs with low flesh content and rearing of juveniles from the wild or hatcheries to market size. Both of these approaches are usually pond based with or without mangroves. Fattening employs intensive feeding while the later could be done without supplemental feeding that involves low stocking in large mangrove silviculture ponds. In particular, mud crab fattening refers to the rearing of empty crabs identified at harvest from the wild or from farm stocks for a brief period of time until weight is gained and ready to market (FAO, 2011). Empty crab also called as thin crab, water crab or soft shell crab refers to a crab after moulting having thin and soft carapace with little flesh for male and little ovary tissue for female. Various structures can be used to fatten mud crab for relatively short period of time around 15-30 days that include cages, ponds or tanks. Fattening can be held at fairly high densities provided that water quality is optimum, feeding is regular and the rearing environment is free from diseases. Several studies demonstrated that mud crab fattening is a profitable aquaculture activity (Trino and Rodriguez, 2001).

In the country crab fattening has been widely practiced but varies widely in the different regions due to limited baseline research studies. Trino and Rodriguez (2001) studied crab fattening in ponds and found out that it is economically feasible and production could be very high. Technology verification done by Southeast Asian Fisheries Development Center (SEAFDEC) and a few private individuals using bamboo cages with individual cells or compartments that held one crab per cell resulted to high survival and better weight gain. Nonetheless, the experiments only

focused on the structures for rearing but not on feeding management which is also a very important aspect to achieve maximum economic benefit. Fattened crabs are usually fed with a mixed diet of trash fish and mollusk at a ration ranging from 6-10% body weight (SEAFDEC, 2011). Studies using cheaper feed alternatives in crab fattening are limited. This study will evaluate the feasibility of golden apple snail or locally known as “kuhol” as a substitute of the usual diet of mud crab.

OBJECTIVE

The main objective of the study was to determine the effect of experimental fattening of mud crab (*Scylla serrata* Forskal) using different feed types (trash fish, golden apple snail and combination of trash fish and golden apple snail) on the following indices:

- a. growth in terms of absolute growth rate, total carapace length and width
- b. survival and moulting incidence
- c. yield and quality of picked meat

METHODOLOGY

Location and Cage Design

The experiment was conducted in BISU Calape-Calunasan Brackishwater Station. A cellular system cage design adapted from SEAFDEC was used. The modified bamboo cage had a dimension 2 m x 0.9 m x 0.3 m and divided into 15 compartments, covered with plastic screen for feeding and sampling convenience. The cage was firmly fixed by its corners to the substrate using bamboo stakes to prevent it from being washed away in high weather. The cage was placed in the pond canal with $\frac{3}{4}$ of its body submerged during the lowest low tide. The set up is ideal for mudcrab culture as water exchange takes place naturally through tidal fluctuations.

Procurement of Stocks and Stocking

Mixed sex crabs with similar sizes weighing 50-100 g were purchased from local fishermen in Calape at PhP 100.00 per kilogram. The crabs were weighed (77.78 g) and carapace length (72.47 mm) and width (50.87 mm) were measured individually. Crabs were individually held in the compartment or “cell” in the cage. A total of 15 crabs were stocked for each treatment corresponding to the different feed types. Stocking was done late in the afternoon.

Rearing

The crabs were reared for 15 days. Water quality parameters such as salinity, temperature and pH were monitored daily. The cages were cleaned daily by removing excess feeds and waste. Drifted debris that clings in the cage was removed to prevent damage in the cage and to easily facilitate water circulation. Six crabs from each treatment were weighed and carapace length and width were measured every three days as basis for the feed ration.

Diet Preparation and Feeding

The feeds used in the experiment were trash fish, golden apple snail and combination of trash fish and golden snail. Trash fish was bought from the local market, washed with clean water and stored in freezer. Golden apple snails were collected in the nearby rice fields and were purged by soaking in clean water for 24 hours. Frozen trash fish was thawed in running water and meat of the golden apple snail was separated by breaking the shells individually and weighed based on the exact feed ration. A feeding rate of 10% body weight was employed (SEAFDEC, 2011). Feeding ration was increased based on the body weight of the crabs measured every three days. Feeding was done twice a day, 7 am and 4 pm.

Sampling and Harvesting

At an interval of 5 days, all mudcrab in each cage were netted, weighted and recorded for analysis of growth and survival. Measurements were done using a calibrated weighing scale recorded in grams. After days, survival was assessed by counting remaining stocks in the cage. Final body weight, carapace length and width were measured. Survival rate, absolute growth rate, specific growth rate and feed conversion ratio were computed.

Picking and Sensory Evaluation

All the harvested crabs were steamed. The meat was then carefully separated from the shell and weighed. After weighing, nine panellists evaluated the sensorial attributes in terms of aroma, texture and taste using the simple 9-point Hedonic Scale (9-extremely like, 8-like very much, 7-like moderately 6-like slightly, 5-neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much, 1-dislike extremely).

Statistical Tools and Analysis

Data were statistically analyzed using descriptive statistics particularly; mean, standard, and percentage. Mean of treatments were compared by Analysis of Variance (ANOVA) at 0.50 confidence level.

RESULTS AND DISCUSSION

Water Quality

The ranges of the water quality parameters (salinity: 25-35 parts per thousand (ppt); temperature: 25-30 °C; pH: 7.5-8.7) recorded during the experiment are within the suitable levels and the culture period (15 days) is within the duration being practiced for mud crab fattening (Cholik and Hanafi, 1992). Placing the cages in the pond canal was ideal because water was continuously flowing maintaining optimum water quality conditions. The preliminary experiment conducted inside the pond resulted to poor growth and survival that could be attributed to poor water quality as water exchange was limited.

Growth, Survival and Moulting Incidence

The mean final weight of the crabs after 15 days of fattening ranged from 90 g to 100 g in all treatments (Table 1). Crabs fed with a combination of trash fish and golden apple snail had the highest mean final body weight at 100.20 g with a total weight gain of 21.93 g. Begum et al (2009) reported relatively lower weight gain at 10-16 g in mud crab with initial weight of 200 g fattened in ponds for 16 days fed with tilapia. In the experimental fattening of mud crab in ponds using trash fish by Trino and Rodriguez (2001), weight gain was relatively higher ranging from 150-200 g with initial weight of stocks at 260-280 g. The lower weight gain observed in the current experiment could be attributed to the use of small stocks and possibly the thinness of the muscle of the crabs initially used (Liong, 1993).

Specific growth rate was highest in mud crab fed with golden apple snails and combination of trash fish and golden apple snails (Fig. 4) at both 1.54% day⁻¹. Specific growth rate of mud crab in all the treatments were comparable to that of mixed sex mud crab reared in ponds fed with trash fish for 20 days with specific growth rate of 0.8± 0.12% day⁻¹ (Trino and Rodriguez, 2001).

Table 1 Mean initial and final body weight, weight gain and carapace width and length of crabs after 15 days of fattening using different feed types

Treatment	Initial wt (g)	Final wt (g)	Wt gain (g)	Carapace width (mm)	Carapace length (mm)
Trash fish	77.73	90.71	12.98	50.93	72.29
Golden apple snail	77.33	97.53	20.20	51.07	70.87
Trash fish+Golden apple snail	78.27	100.20	21.93	52.07	74.53

Survival was highest in crabs fed with golden apple snail and combination of trash fish and golden apple snail at 100% (Table 2). The result was relatively higher compared to that of Begum et al. (2009) wherein survival rate of crabs reared in cages was only 93.75%. High survival was attributed to the use of cellular cage system. Crabs were held individually to prevent cannibalism and as well as to provide optimal environment for growth.

Another primary use of the cellular cage is the production of soft-shell crabs or newly moulted crabs (FAO, 2011). In this kind of system, small mud crabs are reared in isolation a few weeks until they moult. Soft-shell crabs command higher price and farmers have focused on soft-shell production to maximize profit. In the present study, moulting incidence was observed as an effect of the dietary treatment. It was found out that moulting was significantly affected by diet types; 20% of the crabs fed with golden apple snail and combination of trash fish and golden apple snail moulted during the experiment while none of the crabs moulted in the group fed only with trash fish. The use of golden apple snail could have accelerated moulting incidence. High calcium content of the diet (from the shells of the golden apple snail) could possibly induced moulting of stocks but this needs to be further investigated.

Table 2 Survival, occurrence of moulting and production of mud crab using different feed types

Treatment	Survival (%)	Moulting (%)
Trash fish	93	0
Golden apple snail	100	20
Trash fish+Golden apple snail	100	20

Economic Analysis

As to stocking density, the present study following the stocking density suggested by SEAFDEC (SEAFDEC, 2011) and still yielded a comparable survival rate of >90%. Tables 3 and 4 provides an overview on the economic analysis of different fed types for mudcrab in cellular cages. Mudcrab fed with golden apple snail constitute the high return of investment compared to the other treatments as indicated that low expenses incurred during the conduct of the study because feeds are readily available.

Meat Yield and Quality

There was no significant difference in the yield of picked meat (Table 5) and overall acceptability scores in terms of taste, texture, aroma and color among the three treatments (Table 5). The mean score among the three treatments was 8 which is equivalent to like very much in the Hedonic Scale. The results suggested that sensory attributes of mud crab fed with golden apple snail were comparable to that of mud crab fed with trash fish.

Table 3 Return-on-investment of the 3 units 2 m x 0.9 m x 0.3 m cellular cages at different fed types

ROI Parameters	Unit	Input						Income		
		T ₁	T ₂	T ₃	T ₁	T ₂	T ₃	T ₁	T ₂	T ₃
Total harvest(-ind)	pcs	15	15	15						
AWG	g	12.98	20.20	21.93						
Total biomass	kg	0.195	0.303	0.329						
Gross income								48.75	75.75	82.75
Less: Total expenses					40.00	70.00	75.00			
Net income								8.75	5.75	7.75
ROI								21.88%	8.21%	10.33%

**the Php 250.00-300.00 per kg was based on the actual market price of mudcrab at Calape Public Market*

Table 4 Weight of the picked meat and carapace and the corresponding yield

	Picked Meat (g)	Carapace Weight (g)	Total (g)	% Yield
Trash Fish	31.51	9.46	40.97	76.97
Golden Apple Snail	41.22	8.85	50.07	82.07
Trash Fish+Golden Apple Snail	37.74	7.10	44.83	84.09

Table 5 Sensory evaluation scores of the panellist in terms of overall acceptability

Panelists	Trash fish	Golden apple snail	Trash fish+Golden apple snail
1	8	9	7
2	8	9	7
3	8	9	7
4	8	8	8
5	8	8	8
6	8	7	8
7	7	8	9
8	8	7	9
9	7	9	8
Mean	8	8	8

CONCLUSION

The growth, survival and picked meat yield and quality of mud crab fed with golden apple snails were comparable to that of mud crab fed with trash fish. The results indicate that golden apple snail collected from nearby rice fields could be a potential dietary substitute for trash fish in mud crab fattening.

RECOMMENDATION

The same experiment could be conducted using bigger stocks weighing 200 g. It is interesting to evaluate if there is a significant difference between the growth of male and female individuals. Other fattening duration could be tried using the same dietary treatments. Changes in the proximate composition of the mud crab before and after fattening is also very essential to determine the effects on the nutritional state of the organism.

ACKNOWLEDGMENT

We would like to express our sincerest gratitude to the 4th year BS Fisheries students Jeffrey Infiesto, Francis Josol, Rinalyn Bulala, Maricris Remojo and Jomel Baobao for the assistance in the conduct of the experiment.

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