Journal of Fisheries & Livestock Production

Azam and Koroi J Fisheries Livest Prod 2013, 1:3
http://dx.doi.org/10.4172/jflp.1000108

Research Article Open Access

Formulation of Cost Effective Grow out Feeds for *Macrobrachium rosenbergii* Culture in Fiji

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Abstract

The change from traditional subsistence to semi-intensive is leading to an increase in the demand for aquaculture feeds. The culture of freshwater prawn, *Macrobrachium rosenbergii* in Fiji as protein source and source of income for small-scale farmers is important. However, due to the unavailability and high cost of feed ingredients and formulated feeds, the supply and quality of feeds for aquaculture development is restricted. In addition, the lack of information on cost–effective channels to deliver feeds to farmers has contributed to the poor production and profitability. A nutritional study was conducted to evaluate growth performance of *M. rosenbergii* fed iso-energetic, low cost formulated diets, using locally available ingredients in ponds for 124 days. Two formulated (MBM+MM+CP-diet 1 and FM+Wht-diet 2) and two commercial (Crest tilapia pellet-diet 3 and Pacific prawn pellet - diet 4) diets were fed. The study indicated no significant differences for weight gain and survival rate ($P \geq 0.05$). It was observed that diet 2 induced highest growth rate while the lowest FCR (0.97 ± 0.02) value was obtained for the same diet. The survival of prawns ranged between 83.43 mm ± 5.55 and 89.26 mm ± 0.40%. The highest prawn production was obtained with diet 2 at 0.16 kg/m^2. The economic analysis of *M. rosenbergii* production showed that diet 2 was the least expensive (FJ $0.53) to produce 1 kg of prawn as compared to the commercial diets (Pacific Prawn feed –FJ $0.89 and Crest Tilapia feed–FJ $0.69). Therefore, this study suggests that *M. rosenbergii* growth was slightly improved when using the formulated diet 2 although the highest survival rate (89.26 ± 0.40%) was obtained from the formulated diet 1. Diet 2 may be recommended to the farmers for monoculture of *M. rosenbergii* in ponds in comparison to both commercial diets in Fiji.

Keywords: *Macrobrachium rosenbergii;* Formulated diets; Commercial diets; Growth rate; Costs

Introduction

Fiji has a strong domestic market demand (approx. 700 tons/yr) for shrimp (retail price US $14 to 17/kg), but only 150 tons can presently be provided by local sources and the remainder is imported from overseas Pickering [1]. Currently, Fiji imports over 70 percent of shrimps for local consumption with total imports estimated to be around 600 metric tons valued at approximately FJ $15.2 million annually from Australia and Solomon Islands to mainly feed hotel industry FTIB [2]. Farm gate prices of *M. rosenbergii* prawns have decreased to FJ $20 per kg and $25 per kg for retail. However aquaculture in Fiji only accounts for less than 10 percent of the value of all fishery exports.

Freshwater prawns were first introduced in Fiji in 1982 with the assistance of the Japan International Cooperation Agency (JICA) [3] for a project that sought the production of post-larvae that was based in Naduruloulou Research Station (NRS) to try and successfully spawn *M. rosenbergii*. The spawning success has contributed to the development of freshwater aquaculture in Fiji and other Pacific nations. Resources allocated to this hatchery and administrative issues.

A limited number of ingredients are used in the formulation of feeds used in semi-intensive aquaculture in Fiji. Tuna is imported from Taiwan and Japan to process into canned fish. Two sub-products are produced after processing: fish meal and meat and fish meal. According to chemical analysis provided by a technician at Pacific Fishing Company (PAFCO) Ltd, the protein level is 52 percent. Both fish and meat products are priced at FJ $0.80/kg and production of 76,850 MT of 300-400 bags of 45 kg each ACIAR [4]. Fiji Meat Industry Board (FMIB) abattoir in Nasinu produces for cattle, pig, ship and goat and as a sub-product produce meat bone meal. This product costs FJ $0.76 and analysis obtained from the company show the product to contain 48% crude protein content Peter [5].

Evergreen Rice Mill in Navua and Rewa Rice Ltd in Dreketi mills imported rice from Thailand. Evergreen Rice produces two sub products of rice bran and broken rice with an average production between 2.5-6.3 ton/month at prices of FJ$0.60 and 0.33 respectively. Rewa Rice produces 3 tons of pollard rice, broken rice and rice husk at prices FJ$0.28, 0.40 and 0.04 respectively [5].

Flour Mills of Fiji (FMF) produces mill mix, rice bran and pea mill as sub-products of milling. Production is continuous at 84 ton of mill mix and 12 ton/day of rice bran and pea meal daily. Prices at mill mix FJ$0.31 and rice bran and pea mill at FJ$0.56. [5].

In Fiji, the use of rice bran, mill mix and coconut mill in commercial stock feeds for tilapia and prawn culture began in the early 1980's Gonzalez [6]. In 1984, research on aqua feed formulation and feeding trials began at Naduruloulou Research Station (NRS). Following this research, a tilapia commercial pellet was produced in 1998 and is now produced and sold by Crest Feed Mill Ltd. Currently; this commercial tilapia pellet is being used by some semi-commercial and commercial tilapia and prawns farmers [6].

All feed mills in Fiji are owned by the private sector with the exception of NRS feed making plant which is used for experimental diets [6]. Crest Feed Mill Ltd. is the largest feed producer and purchases most of its feed ingredients such as fish meal, soybean mill, vitamin premix and mineral premix from New Zealand. Flour Mill of Fiji Ltd produces mill mix and its subsidiary companies produce coconut oil and coconut meal. A local producer of fishmeal is Pacific Fishing Company Limited in Levuka, but its quality is very variable. Meat and bone meal is produced by Fiji Meat Limited in Nasinu and rice by

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Received July 01, 2013; **Accepted** July 27, 2013; **Published** August 03, 2013

Citation: Azam K, Koroi T (2013) Formulation of Cost Effective Grow out Feeds for *Macrobrachium rosenbergii* Culture in Fiji. J Fisheries Livest Prod 1: 108. doi:10.4172/jflp.1000108

products such as broken whole grains, rice bran and rice pollard can be obtained from numerous rice mills.

Farm–made aqua feeds for tilapia and prawn culture is rare but various combinations of local ingredients have been used by successful farmers. In addition to purchasing the current tilapia pellet from Crest Feed Mill, farmers prefer using a mash consisting of 40 percent coconut meal, 35 percent mill mix and 25 percent meat and bone meal which was formulated at NRS in 1988 [6].

Despite information available on the nutritional requirements of prawns, farmers do not have access to this information nor knowledge on how to utilize such information. In addition, the suitability of local ingredients available to farmers in Fiji, appropriate inclusion levels in diets, methods of processing and economics of using such ingredients is poorly understood. Since the cost of commercial tilapia or prawn pellet is too high (FJ $1.52/kg), farmers are limited in the choice of alternatives since recommendations on the use of locally available material is not available to the farmers.

Thus, the present investigation was carried out to develop two formulated diets incorporating local ingredients and to conduct *M. rosenbergii* growth trial in ponds comparing against two local commercially-available feeds. Cost analyses were also carried out for both formulated and commercial diets.

Materials and Methods

Local ingredients

The local ingredients available in Fiji with costs and sources are shown in Table 1. The feed ingredients were purchased in 35 kg bags and stored in the freezer at the Wet-lab. Feed stuff was analyzed at the QDPI laboratory in Brisbane, Australia. Not all the ingredients were used in the formulations as it was not available in supply at the time of experiment and obtaining these ingredients was not economical due to shipment expenditure.

		Price/ton	
Ingredient	**Source**	**FJD$**	**AUS$**
Copra meal	Rewa Dairy Fiji Ltd,Suva	580	480
Fish meal	Pacific Fishing Company, Ltd, Suva	800	662
*Meat bone meal	Fiji Meat Industry Board, Suva	760	629
*Meat fish meal	Pacific Fishing Company, Ltd, Suva	800	662
Mill mix	Flour Mills of Fiji, Suva	350	289
Pea meal	Flour Mills of Fiji, Suva	550	455
Rice bran meal	Evergreen Rice Ltd, Navua	560	463
Wheat	Flour Mills of Fiji Ltd, Suva	825	682

Table 1: Raw ingredients and suppliers in Fiji.

Pond	Pond area (m^2)	Stocking density	Stocking number
1	113	7	791
2	116	7	812
3	105	7	735
4	105	7	735
5	121	7	847
6	100	7	700
7	126	9	1134
8	138	9	1242
9	138	9	1242
10	149	9	1341
11	140	7	980
12	157	7	1099

Table 2. Pond dimensions and stocking density for the *M. rosenbergii* pond nutrition experiment conducted for 124 d. (ponds 1, 5, 9: Diet 1, ponds 2, 6, 10: Diet 2, ponds 3, 7, 11: CTP and ponds 4, 8, 12: PPP).

Experimental set up

Twelve rectangular earthen ponds of different size were selected and prepared for stocking. Four treatments were assigned with three replicates per treatment diet (Table 2).

Formulation and feed preparation

Two experimental diets were formulated in this study. Diet 1 used premium local ingredients (fish meal and wheat) of highest quality in the feed in order to achieve the best growth performance regardless of cost while Diet 2 was formulated from cheaper ingredients (meat bone meal, mill mix and copra) while meeting the basic prawn nutritional requirements. The experimental diets were formulated to be iso-nitrogenous (32 percent) CP and iso-energetic (19 MJ/Kg) on a dry matter basis. In order to evaluate their relative performance, the two experimental formulations were tested against two commercially available feeds (Crest Tilapia Feed and Pacific Prawn Feed). Crest Feed Mill sells tilapia pellets at $31.32 per 25 kg bag and freshwater prawn pellets at $40.20 per 25 kg bag. Pacific Feeds Limited sells the same pellets at $25.00 and $37.00 respectively per 25 kg bag.

The experimental diets were prepared by grinding some of the ingredients using a crumbler to obtain fine powder. Ingredients were then weighed as per formulae using a scale and placed in a mixer. While mixing, water was gradually added to obtain a wet consistency forming dough. Once ingredients were thoroughly mixed, this was screw pressed through a pelletizer using a 4 mm size pellet die. The two commercial diets were crumbled, mixed with water and re-pelletized with the same size as the experimental diets. Fifty kilograms of each diet was prepared using the same process. The resulting pellets were dried for 4hours in a kerosene operated oven at 60°C. Once dried, the pellets were placed in 25kg bags and placed in an air- conditioned room for storage. Samples of each diet were sent to QDPI laboratories for analytical composition soon after manufacture.

Pond preparation and stocking

The experimental ponds were drained, overgrown grass removed; pests eradicated eel nets placed at inlets and limed a week prior to filling with water. Each pond was supplied with 2 aeration lines. The water turnover rate was about 5-10% per day and prawns were held under natural light (12 h light: 12 darkness) schedule.

According to a joint research associated with this [4] project, the GFP (Giant freshwater prawn) Vietnam strain was identified as the best performing line thus was used in this study. Once this strain had reached post larvae, 15,000 were transferred from the hatchery to a quarantine facility for nursery culture in raceway tanks for three weeks at NRS. Post larvae of freshwater prawn were kept in raceway tanks at a density of 300 prawns/m2. The PLs were fed the commercial crest tilapia pellet.

The freshwater PL was counted and average initial weights and lengths of animals taken. Animals of the same age of average initial body weight 0.083 g and average length 19.03 mm were randomly selected and stocked into the experimental ponds at stocking density of 7 and 9 PL/m^2 of total area.

Feeding and data collection

Animals were initially fed 5% body weight per day for the first

month and this decreased to 3% body weight by the second through to fourth month. The daily feed ration (DFR) was calculated using the formula provided by Jayachandran [7], DFR = stocking population x survival rate x average weight of prawn x% of feeding rate. The daily ration of feed was divided equally and offered twice daily (9:00 am and 4:00 pm). The feeds were dispersed by hand broadcasting over the water. No fertilizer was used during the culture period. The growth performance indices during the experimental period were conducted by netting out 100 animals per pond every month and weighing individual animals using a Professional Scale® (GS-100. accuracy of ± 0.01g) electronic balance. The first sampling was done on the 28th of April and 28 days consecutively for each month thereafter. Final harvest was conducted on the fourth month after 124 d (Table 3). The water level in each pond was reduced to approximately 0.5 m at the drain end. On the first day of harvest, each pond was seined 2 times and then completely drained. The remaining prawns were then manually harvested from the pond and placed in buckets of water and transported to the hatchery for individual prawn weighing. The increase in length and weight were used as measures of growth.

Water quality parameters

The water quality parameters such as temperature (°C), dissolved oxygen (mg/L) and pH were monitored twice daily to ensure that water quality remained well within the limits recommended for giant freshwater prawn. The temperature and dissolved oxygen were measured using a Handy Polaris® (OxyGuard) meter and pH was measured at 10cm below water surface using a YSI® pH meter (model pH 100).

Calculations

Growth performance, survival rate and feed intake

Weight gain (WG), total body length gain (BLG), specific growth rate (SGR; % per day) feed conversion ratio (FCR), protein energy ratio (PER) and survival (%) were all calculated as follows:

WG = Final body weight (g) – Initial body weight (g)

BLG = Final body length (g) - Initial body length (g)

SGR = (In FBW – In IBW) / t x 100; where FBW is final body weight; IBW is initial body weight;

In = natural logarithmic; t = time in days

FCR = Feed intake (g) / weight gain (g)

PER = live weight gain (g) / protein intake (g)

S (%) = (final number of prawns – initial number of prawns) x 100

Means and standard deviations were calculated and expressed as mean ± SD.

Production costs

The production costs were calculated as follows:

Initial Biomass = 0.08 g x initial number of prawns

Final Biomass = final weight (g) of prawns x final number of prawns

Product (g) = final biomass (g) – initial biomass (g)

Cost of feed (FJ$) = total feed (kg) x cost of diet (FJ$)

Cost of feed (AU$) = total feed (kg) x cost of diet (AU$)

Cost to produce 1kg prawn = FCR x cost of diet (FJ$)

Statistical analysis

The data obtained was statistically analyzed by performing analysis of variance (ANOVA). The effect of different diets on FBW, WG, SGR, FCR, PER and S (%) were carried out using one way ANOVA assuming significant level ($P \leq 0.05$). Water parameters were also analyzed using one way ANOVA.

Results and Discussion

Proximate analysis

The proximate analyses of the experimental and commercial diets are shown in Table 4. The crude protein was around 32 % for the experimental diets and 22.8 % for Crest Tilapia Pellet (CTP) and 30.3 % for Pacific Prawn Pellet (PPP). The crude fat content was 10.2 % for Diet 1 and 11.5 % for Diet 2. The gross energy ranged from 18.2 to 19.3 MJ/kg with Diet 1 showing highest gross energy content and CTP showing the lowest.

Growth Performance, Survival Rate and Feed Intake

The evaluation of *M. rosenbergii* growth performance, survival rate and feed intake in the different diet treatments are summarized in Table 5. Growth performance, survival rate and fed intake of prawns fed the four experimental diets were not significantly different among treatments. This noticeable similarity can be explained by the high variation within the experimental groups. From highest to lowest in weight gain (g) order it was observed that Diet 1> Pacific prawn pellet > Crest tilapia pellet >Diet 2. An FCR of 0.97 ± 0.01 was obtained for Diet 1, followed by the PPP of 1.09 ± 0.12, CTP of 1.10 ± 0.06 and Diet 2 of 1.14 ± 0.02. The mean weight gain values ranged between 6.06 ± 1.50 to 9.28 ± 0.42 g. The mean SGR values of prawns in different treatments ranged between 1.94 ± 0.28 to 2.27 ± 0.07 %/day. The FCR values ranged between 0.97 ± 0.02 to 1.16 ± 0.08. The PER values ranged between 2.79 ± 0.32 to 3.99 ± 0.20. Survival (%) of prawns varied between 83.05 ± 3.22 and 88.84 ± 0.48 %. New and Singholka [8] suggested that a survival rate above 50 percent between stocking and harvesting is acceptable. According to Abramo et al. [9], survival rate of giant freshwater prawn in earthen ponds ranged from 54 to 89 percent. Daniels et al. [10] also reported the survival rate of prawns in earthen ponds fed a specifically

Ingredient	Diet 1	Diet 2	CTP	PPP
FM	44.5	10.00	Crest Tilapia Pellet	Pacific Prawn Pellet
MBM	0.00	32.95		
Mill mix	0.00	55.05		
Copra meal	5.00	0.00		
Pea meal	5.00	0.00		
Wheat	43.50	0.00		
Premix	2.00	2.00		

Table 3. Formulation (%) of experimental grow-out diets for *M. rosenbergii* pond grow-out trial for 124 d. (Experiment 3).

Components	Diet 1	Diet 2	CTP	PPP
Dry matter	90.1	94.9	90.2	91.0
Ash	13.1	11.2	10.9	12.3
Crude protein	32.8	32.2	22.8	30.3
Lipids	10.2	11.5	5.3	8.7
GE MJ/kg	19.3	20.1	18.2	19.2
FJ$/kg	1.08	0.71	1.20	1.52
AU$/kg	0.58	0.38	0.64	0.81

Table 4. Proximate compositions of experimental diets and commercial diets (% DM basis).

formulated diet to be 74 to 82 percent. Survival has more to do with the cannibalistic nature of the prawns, the male hierarchy and predation than feed. Different stocking densities used for all diets did not show any difference in either growth performance or survival.

The protein content and quality of the feed eaten is an important factor for growth. In terms of how fast prawns grow will depend not only on the amount eaten but the quality of the ingredients providing the animal with the necessary nutrients and in the right quantities. The growth of *M. rosenbergii* individuals within a population is highly variable and this may be due to genetics, social structure and environmental factors. Several authors [11-14] suggested that about half of the *M. rosenbergii* population grow rapidly while the other half grows slowly and uniformly. However, more accurate results in terms of growth performance can be obtained by more specific measurements, such as individual stocking, i.e. individual weights recorded instead of a random sampling assuming homogeneity of weight in the group taking into consideration that *M. rosenbergii* has a territorial behavior and its population does not grow in a uniform way.

The increase in the stocking density of prawns in ponds from 5 PL/m^2 which is the usual practice to 7 and 9 PL/m^2 did not seem to affect growth. Mires [15] successfully stocked *M. rosenbergii* juveniles at 5 to 7.5/m^2 in polyculture with Nile tilapia (*Oreochromis niloticus*).

Obtaining the best performing feed for the most economical price is a challenge. Understanding the FCR is important. Growth studies and FCR vary according to various factors including the nutritional and physical quality of feeds, environment variants such as temperature, intensity of production (availability of natural feed) and other factors including genetics and social structure. The average feed conversion in the study was 1.08. Diet 1 obtained an FCR value of 0.97. Hossain et al. [16] reported FCR value of 3.06-4.85 for prawns. Similarly, Daniels et al. [10] reported FCR value of 2.18-2.43 and Sarma [17] recorded an FCR of 2.35 with a diet containing 37 percent protein for freshwater prawn *M. rosenbergii*. Jayachandran [7] stated that the rate of food consumption increases with increasing prawn size up to a certain age. In addition, he reported a 10-18:1 FCR for raw feeds and 2-3.5:1 for compound diets.

Pond Production: Experimental feed vs. Commercial feed

An average of 972 animals was stocked into each pond with a total weight of 83 g. On average a total harvest of 6.5 kg of prawn was produced from each pond therefore average feed conversion ratio was estimated at 1.08 kg of feed per kg of prawns produced.

There were 2484 prawns fed Diet 1 with this group having a total initial weight of 206 g. After 124 days of experiment using 22.14 kg of feed, a harvested value of 23.25 kg was achieved with an FCR value of 0.97 obtained.

A total of 2530 prawns were fed Diet 2 having an initial weight of 210 g. After 124 days, this group consumed 16.44 kg of feed. A harvest of 15.53 kg was obtained with an FCR value of 1.14 achieved by this group.

The Crest tilapia diet was tested on 2849 prawns with a total biomass of 236 g. Prawns in this group consumed a total of 18.63 kg of feed with a harvest of 20.63 kg and an FCR value of 1.10.

The Pacific Prawn diet was tested on 3076 prawns having a total biomass of 255 g. This group consumed 24.49 kg of feed and a harvest of 22.66 kg was achieved with an FCR value of 1.09 obtained.

Animals fed with Diet 1, showed slightly better results in terms of value for all growth parameters measured, having an average of 33% (9.28 g) better weight gain than Diet 2 (6.06 g) and 22% better than Diet 3 (7.15g) (Table 5)). Diet 1 and commercial Pacific prawn diet showed very similar weight gain results (9.28g and 8.87g) respectively.

Daniels [10] reported a production of 1041-1662kg/ ha for *M. rosenbergii* fed with formulated diet for a 130 day experimental period. William [18] reported 1024-1662 kg/ha for freshwater prawn fed with formulated diet. The prawn production for the 124 d culture period was similar for Diet 1 and Pacific Prawn diet at 0.06 kg/m^2, while Diet 2 at 0.04 kg/m^2 and Crest tilapia diet at 0.05 kg/m^2. Chand et al. [19] obtained similar production of 1483 kg/ha fed a commercial pelleted feed. The lower production figure in this study may be due to the fact that no fertilization was added to the pond to enhance pond productivity because this factor was assumed constant.

Production cost: experimental vs. commercial feed

The production cost analysis for each diet is summarized in Table 6. The economic analysis of *M. rosenbergii* production in the study during a 124 days culture period showed that Diet 1 which was. cheaper (FJ $1.05) to produce 1 kg of prawn as compared to the commercial diets Pacific Prawn feed (FJ $1.66) and Crest Tilapia feed (FJ $1.34).

The development of diets for *M. rosenbergii* prawns requires the fulfillment of the nutritional requirements. The omnivore nature of the freshwater prawn allows the use of a wide variety of locally available feedstuffs including commercial by-products as ingredients in formulated diets. To create a balanced diet, it is necessary to establish the minimum protein level to provide essential amino acids Guillaume

	Diet 1	Diet 2	CTP	PPP	F	P value
Initial weight (g)	0.083	0.083	0.083	0.083	-	-
Final weight (g)	9.36 ± 0.42	6.14 ± 1.50	7.24 ± 1.81	8.95 ± 0.65	1.47	0.29
Weight gain (g)	9.28 ± 0.42	6.06 ± 1.50	7.15 ± 1.81	8.87 ± 0.65	1.47	0.29
Feed intake 124 d	7381 ± 845.40	5478 ± 1063.30	6211 ± 1494.58	8162 ± 1239.95	1.02	0.43
Feed intake 124 d/ animal	8.96 ± 0.35	6.94 ± 1.96	7.81 ± 1.82	9.60 ± 0.39	0.76	0.55
Protein intake 124 d	2416 ± 276.78	1763 ± 342.14	1417 ± 341.00	2469 ± 375.33	2.33	0.15
Protein intake 124 d/ animal	2.93 ± 0.11	2.23 ± 0.63	1.78 ± 0.42	2.90 ± 0.12	2.10	0.18
SGR (%/day)	2.25 ± 0.01	1.78 ± 0.16	1.94 ± 0.16	2.21 ± 0.02	1.74	0.24
FCR	0.97 ± 0.01	1.14 ± 0.12	1.10 ± 0.06	1.09 ± 0.02	0.93	0.47
PER	3.17 ± 0.04	2.79 ± 0.32	3.99 ± 0.20	3.04 ± 0.22	5.61	0.02
Survival (%)	86.68 ± 1.81	88.84 ± 0.48	84.46 ± 2.22	83.05 ± 3.22	1.37	0.32

Table 5: Mean (± s.e) growth and feed utilization for *M. rosenbergii* fed four different experimental diets in a pond experiment conducted for 124

	Diet 1	Diet 2	CTP	PPP	F	P value
Initial No.	2.880 ± 141.92	2853 ± 197.66	2849 ± 116.18	3076 ± 150.92	0.05	0.98
Final No.	2484 ± 108.10	2530 ± 171.09	2849 ± 89.31	2532 ± 106.40	0.03	0.99
Initial weight (g)	239 ± 1.71	237 ± 3.68	236 ± 2.99	255 ± 8.82	1.46	0.10
Final weight (g)	23250 ± 448.27	15534 ± 1228.55	20627 ± 1992.83	22661 ± 775.38	1.99	0.19
Product (g)	23011 ± 446.65	15297 ± 1224.88	20390 ± 1990.98	22406 ± 768.66	1.96	0.20
Total Feed (kg)	22.14 ± 8.45	16.44 ± 10.63	18.63 ± 14.95	24.49 ± 12.39	1.02	0.43
FJ$ of diet	1.08	0.71	1.21	1.52	-	-
AU$ of diet	0.58	0.38	0.64	0.81	-	-
FJ$ total feed	24.00 ± 17.64	11.55 ± 8.56	22.54 ± 15.02	37.22 ± 28.78	0.81	0.52
AU$ total feed	12.77 ± 9.40	6.17 ± 4.56	12.00 ± 8.00	19.81 ± 15.32	0.81	0.52
FJ$ produce 1kg prawn	1.05 ± 0.14	0.80 ± 0.14	1.34 ± 0.12	1.66 ± 0.33	0.83	0.51
AU$ produce 1kg prawn	0.56 ± 0.08	0.43 ± 0.08	0.71 ± 0.07	0.88 ± 0.09	0.80	0.53

Table 6. Comparison of experimental feed and commercial feed for *M. rosenbergii* pond nutrition experiment conducted for 124 days.

Components	Temp (°C)	D.O. (mg/L)	pH
Diet 1	28.3 ± 0.04	9.3 ± 0.14	7.74 ± 0.10
Diet 2	28.3 ± 0.02	9.2 ± 0.16	7.75 ± 0.00
CTP	28.3 ± 0.03	9.0 ± 0.16	7.80 ± 0.02
PPP	28.2 ± 0.03	9.2 ± 0.23	7.78 ± 0.00
F value	2.41	0.39	0.34
P value	0.21	0.77	0.80

Table 7: Water quality values monitored during the *M. rosenbergii* pond nutrition experiment conducted for 124d.

et al. [20]. Based on growth, yield and feed cost it can be suggested that the experimental Diet 1 may be recommended for semi-intensive farmers for monoculture of *M. rosenbergii* in ponds being comparable to both commercial Diets (Pacific Prawn and Crest Tilapia feed) in Fiji. It is also recommended that this formula may be used to boost growth in the later stages, therefore more utilization of primary productivity through efficient fertilization during the early stages to reduce feed cost for farmers.

Water Quality Parameters

During the experimental period water temperature ranged from 28.23 ± 0.03 to 28.29 ± 0.02 °C (Table 7); dissolved oxygen varied between 8.97 ± 0.10 to 9.13 ± 0.16 mg/L and pH ranged between 7.75 ± 0.06 to 7.79 ± 0.02. The water parameters showed no significant differences during the culture period and fall within the suggested ranges for prawn culture having no negative effect on the growth of prawns.

Conclusions and Recommendations

The current commercially available feeds are at present inconsistent in supply and too costly for farmers to purchase. The idea was to produce a diet using locally available ingredients to be easily prepared by farmers as "on farm- feeds" and in the future suggested to commercial feed companies to produce and supply. Locally available ingredients were identified such as fish meal, meat bone meal, meat fish meal, copra meal, wheat, mill mix, rice meal and pea meal. The assessment of selected ingredients locally available in Fiji showed that the inclusion of feed ingredients for the formulation of diets for the giant freshwater prawn is flexible. Commercially, the use of ingredients in formulated feed should be cost- effective and should be available in large quantities in areas where culture operations occur. It is not always necessary that the best diet will be the cheapest but it will produce better growth and lower FCR values which will be more economical in the long- term. In conclusion, the finding of this study was found to be cost effective and efficient as a farm made feed. A limited number of ingredients are used in the formulation of feeds in aquaculture in Fiji. When formulating a diet for freshwater prawn, it is recommended that ingredients be chosen based on nutritional value taking into account the potential anti-nutritional factors rather than on basis of cost per unit alone. Natural food in the pond may have satisfied part of the nutritional requirements of the prawn. Thus, *M. rosenbergii* cultured in ponds can be fed a diet containing a lower dietary protein levels and fish meal compared to prawns grown indoors in tanks. It is recommended that future studies be conducted to determine the extent in which natural foods contribute to the diet of *M. rosenbergii* and encourage enhancing pond productivity to reduce feed costs. Understanding the bioenergetics of the prawn and the interaction of dietary components is important in formulating adequate diets. The ratio of protein to energy is important to consider in formulation of cost effective environmentally friendly diets of prawns. It is recommended that this diet be further tested on commercial prawn farms in Fiji and the region. There is also the need to further train farmers on how to formulate and produce nutritionally balanced feeds. In addition, Government should subsidize the cost of locally fabricated machines to make it affordable to farmers so as to produce on farm made feeds.

Acknowledgement

The authors express their gratitude to Australian Centre for International Agricultural Research (ACIAR) for financial assistance. Also the authors would like to thank ACIAR collaborators of this project Dr. Satya Nandlal, Dr. David Hurwood and Professor Peter Mather for allowing to work on this project with them in their "Freshwater prawn aquaculture in the Pacific region: improving culture stock and nutrition in Fiji". Much appreciation to Dr. William N. Camargo of the University of the South Pacific (USP) and Dr. Carmen Gonzalez of Queensland University of Technology (QUT) for their encouragement, support to conduct the research. In addition, the author would like to sincerely thank the administration staff of USP. The authors are grateful to Dr. Simon Hodge for his assistance with statistical analysis. The authors acknowledge sincerely all the staff of Fiji Fisheries Department based at Naduruloulou Aquaculture Research Station for the provision of post larvae and juvenile prawns, facility and ponds for the research. Much appreciation to Mr. Jone Vasuca, Fiji project Officer for the tremendous help and dedication of his time in assisting with sampling and technical advice.

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Citation: Azam K, Koroi T (2013) Formulation of Cost Effective Grow out Feeds for *Macrobrachium rosenbergii* Culture in Fiji. J Fisheries Livest Prod 1: 108. doi:10.4172/jflp.1000108