Sweet potato (*Ipomea batatas*) as feed for Australian redclaw (*Cherax quadricarinatus)* and implications for its aquaculture in PNG

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Abstract

The ability of the redclaw, *Cherax quadricarinatus*, to grow on a diet of sweet potato (*Ipomea batatas*) was investigated by a feeding trial conducted in a pond at the Walkamin Freshwater Research Centre in Queensland, Australia, over a period of 52 days. Although results were not statistically significant, they do suggest that crayfish can be grown using sweet potato as a supplement in hay-fertilized ponds. Outcomes also support redclaw as a candidate for either subsistence or commercial aquaculture in Papua New Guinea.

Keywords: sweet potato diet, crayfish, subsistence or commercial aquaculture,

Introduction

Redclaw (*Cherax quadricarinatus* von Martens) is a large freshwater crayfish native to northern Australia and the catchments of southern Papua New Guinea (PNG) (Thompson & Muzinic, 2004), including the Fly River system. Since its domestication in the 1980s by the Queensland Department of Primary Industry and Fisheries (DPI&F), redclaw has been farmed throughout northern Australia and abroad in some Central and South American countries. The redclaw is now widely accepted as an aquaculture species in Australia as shown by increased production by Queensland farmers from 89.7 tonnes in 2003-04 to 98.6 tonnes in 2004-05; the 2003-04 harvest having a total value of AUD 1.28 million (Lobegeiger & Wingfield, 2006).

Redclaw is a hardy species able to tolerate a large range of environmental conditions and can be handled and transported easily compared to live finfish. It has no complex larval stage, is a benthic dweller and has an omnivorous diet with cannibalistic tendencies (Webster et al., 2004). Its simple feeding habit makes it easy to grow for farmers with little access to formulated feed to culture.

Sweet potato (*Ipomea batatas*) is a staple for much of the population in PNG and is farmed on a subsistence basis throughout the country. Its availability has led to it being widely used as supplemental feed for livestock. In preparation for redclaw farming trials in PNG, an investigation on the growth of the crayfish fed different treatments of sweet potato was carried out over a period of eight weeks. This paper reports on the experimental findings and recommends redclaw as a candidate for aquaculture in PNG.

Method

The floor of an empty 1200 m^2 earthen pond was covered with 400 kg of hay. Four parallel rows of six cages were laid out in the pond with walkways between them to allow access after ponds were flooded (Figure 1).

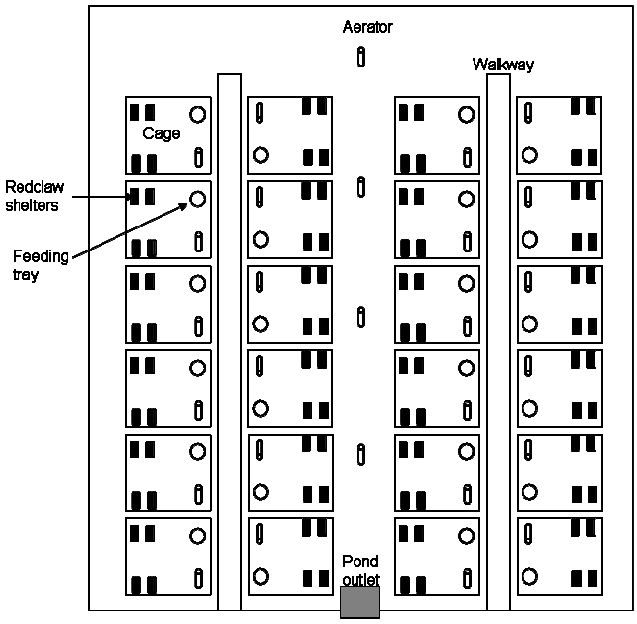

Figure 1: Lay-out of cages, walkways, aeration, feed trays and shelters for redclaw

The experimental cages consisted of a 2.5 x 2.5 x 1.5 m frame made of 90 mm diameter polyvinylchloride (PVC) pipe and covered with plastic net material of 2 mm mesh (Figure 2).

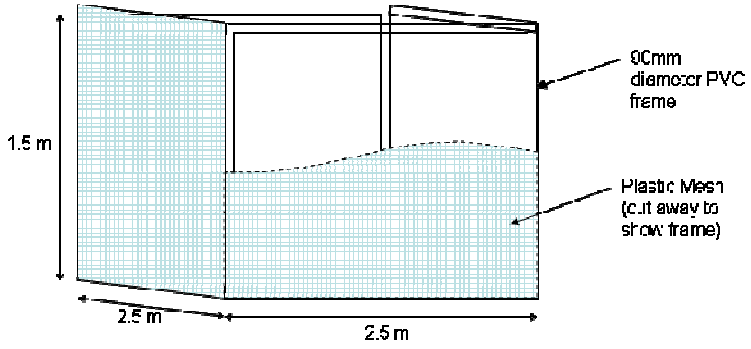

Figure 2: Design of cage used for the redclaw feed experiment. All sides were covered except for the top which was left open.

Three kilograms (kg) of hay was spread on the cage floor of four randomly selected cages. The pond was then flooded to 1.5m depth and 84kg of agricultural grade lime, 10kg of chicken manure and 6kg of urea broadcast over it. Aeration was supplied to the pond. The pond was then left for seven days to commence natural production before the experiment commenced.

Redclaw were harvested from a pond using a flow-trap. The animals were size-sorted using a fish-grader. Fifteen males from the smallest size class (less than 30 g) and ten from the next size-class (30-50 g) were individually weighed and placed in each of the 24 experimental cages to begin the trial.

Cages were randomly assigned six treatments; there were four replicates of each. The treatments were: cooked sweet potato, raw finely-cut sweet potato, raw coarsely-cut sweet potato, sweet potato peelings, hay (no supplementary feeding), and formulated Ridley's Redclaw Feed (control diet).

The redclaw were fed every Monday, Wednesday and Friday. Preparation of treatment diets on feeding days was as follows: tubers were peeled and individual requirements for each cage weighed.

- In the cooked treatment, weighed portions were boiled and allowed to cool before feeding.
- In the raw-finely-cut treatment, the weighed portions were cut into approximately 2 x 2 x 10 mm pellet-sized pieces before feeding.
- For the raw-coarsely-cut treatment, weighed portions were cut into approximately 25 x 25mm blocks for feeding.
- Peelings for the peels treatment were weighed and soaked in water to ensure they sank when introduced to cages.
- The control diet was weighed and delivered.

For all treatment diets, the amount of feed supplied to each cage started at 2% of the total body weight of all animals in each cage. Feed supplied thereafter was adjusted based on observation of the amount of feed accepted by the animals. Water quality readings (dissolved oxygen, temperature, and pH) were taken every Tuesday and Thursday using a YSI™ multiparameter probe. After 52 days, the pond was drained, the animals collected from the cages and individually weighed. Statistical analysis of the data between treatments was done by analysis of variance using GenStat 8.1

Results

The animals grew on sweet potato but those in the hay treatment, which fed on the hay and natural food such as insect larvae, performed far better.

Redclaw survival was high, ranging from 84 to100%. However, statistically the results were not significant.

The feed conversion ratio for the hay treatment could not be determined.

Table 1: Initial and final average weight (± standard error), weight gain per animal, survival rate (SR) and feed conversion ratio (FCR) estimated for redclaw fed diets of different treatments of sweet potato

#	Diet	**Initial wt (g)**	**Final wt (g)**	**% wt gain**	**% SR**	**FCR***
1	Control	33.1 ± 0.9	43.9 ± 1.4	32.6	95	2.78
2	Hay	33.0 ± 0.8	39.6 ± 1.1	20.1	100	-
3	Cooked	33.3 ± 0.9	38.0 ± 1.3	13.9	84	11.60
4	Peels	31.2 ± 1.0	35.9 ± 1.1	15.0	86	6.28
5	Coarse	32.6 ± 0.8	35.8 ± 1.0	9.8	91	7.83
6	Fine	33.5 ± 0.8	38.7 ± 1.0	15.5	91	5.25

* FCR = Feed supplied/animal; Final wt – Initial wt

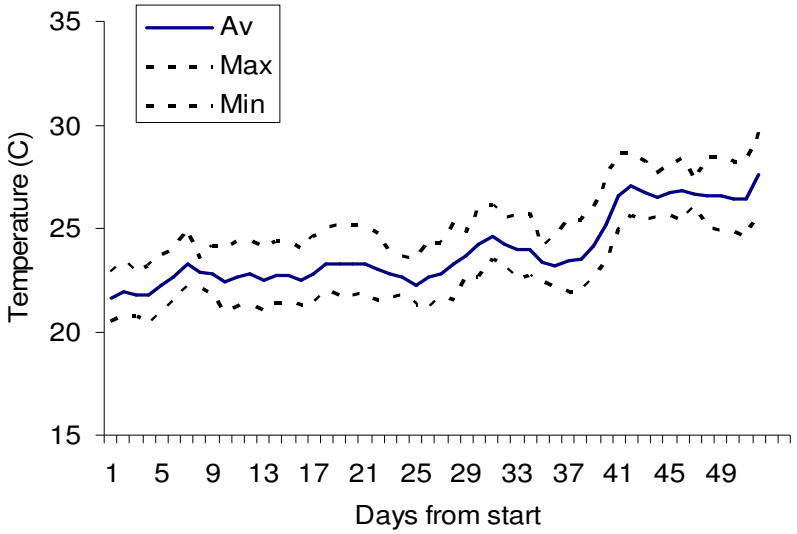

Figure 3. Mean, maximum and minimum temperatures of pond water in redclaw feed experiment cages.

Discussion

Various authors have shown that the redclaw digestive system has cellulose enzymes that enable it to consume diets containing plant material efficiently (Loya-Javellana et al., 1993; Pavasovic et al., 2006). Moreover, juvenile redclaw are omnivorous and able to efficiently consume diets containing plant-derived and animal-derived ingredients; however they digest plant-derived ingredients more efficiently (Campana-Torres et al., 2005). Although results in this trial did not show significant statistical differences, data in Table 1 suggest that redclaw can be grown on sweet potato. In all sweet potato-fed treatments (diets 3-6), there was a weight gain ranging from 9% to 15%, and average survival was greater than 80%. .

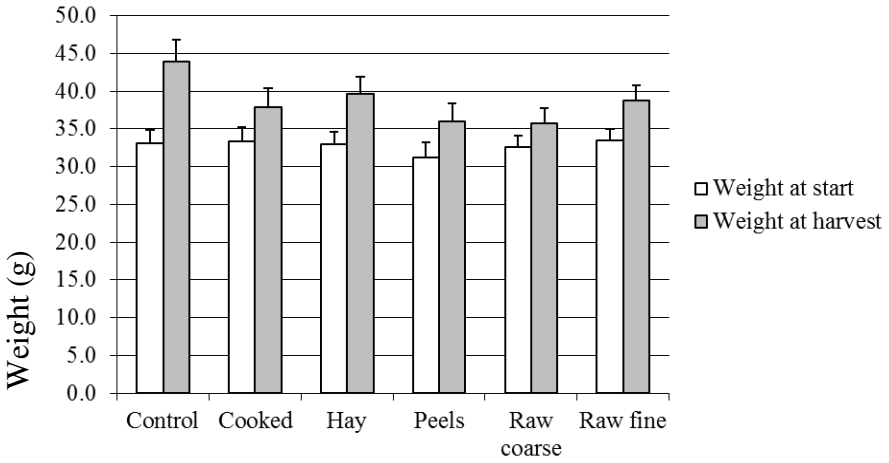

Figure 4. Redclaw growth

Comparing diets 3-6, results in Table 1 show that animals fed on peels (diet 4) and finely cut sweet potato (diet 6) performed better than those on diet 3 (cooked) and diet 5 (coarsely cut).

Redclaw naturally tend to remain near shelter in the wild and in culture to avoid predation. Duffy and Hay (1991) suggest that its food selection and foraging behaviour may be strongly influenced by shelter requirements, similar to the behaviour shown by other animals. It stands to reason that food that can easily be carried into shelters for consumption will be preferred over larger portions. Diets 4 and 6 were small and light enough to be transported into shelters and results suggest that they were preferred to the bulkier portions of cooked and coarsely-cut sweet potato. This phenomenon was observed during feeding times where diets 4 and 6 disappeared quickly while 3 and 5 remained.

Although not as good as the control, animals in the hay treatment (diet 2) did far better than diets 3-6. It has been shown that decayed plant material is the food source chosen by young and sub-adult redclaw if given the opportunity to choose between decayed plants and zooplankton (Loya-Javellana et al., 1993). Results from work done by Fletcher & Warburton (1997) show that juvenile *C. quadricarinatus* of size 1-10 g are able to utilise detritus in the same way as do larger crayfish. In comparison with the sweet potato treatments, it appears that the hay provided a less stressful environment because of its added shelter which allowed for better foraging; food was always available for crayfish in the hay treatment (detritus and aquatic insects) whereas the crayfish in the other treatments had to wait for feeding times when their food ran out.

Studies have shown that juveniles of *C. quadricarinatus* can tolerate long periods of starvation or low food availability by catabolising stored energy sources such as protein (Gu et. al, 1996). Although not statistically significant, the better percentage weight gain by animals in the hay treatment possibly

supports this view. Animals were also able to easily carry decaying plant material close to or into shelters for consumption with low risk of predation (cannibalism by other redclaw). The strategy of carrying plant material into shelters for consumption is reflected in the survival in this treatment being the highest (100% survival). Feed conversion ratio for the hay treatment could not be determined as there was hay left over and some of the digested material had been fed on by other, small aquatic invertebrates.

Redclaw grow well at water temperatures between 22-32^{o}C (Jones, 1989). Temperatures remained below 21 ^{o}C for the first half of the trial period and never exceeded 28 ^{o}C (Figure 1). This low water temperature was unusual for that time (B. Herbert, pers. comm., 2006) of the year because the experiment was carried out towards the middle of summer. Results may also have been different if the trial had gone on for another month. The unusually cold weather, in combination with a short experiment period, was probably the main reason for lack of a significant difference between treatments. Pond water dissolved oxygen (DO) levels were, on average, 7.83 ± 0.16 mg/l; and the pH was 7.68 ± 0.07. Both these levels were well within acceptable levels for culture.

Results from this experiment suggest that redclaw can be grown on sweet potato feed, and that if cultured in a pond lined with hay they will grow well. A combination of a hay-lined pond and supplemental feeding with sweet potato or, preferably, pelleted feed can produce significant growth. It is suggested that hay be added at 1 kg per 30 m^2 while supplemental feed be demand-fed.

The ability of redclaw crayfish to grow and survive well on food in hay-lined ponds and on foods people can grow (e.g. sweet potato) indicates that redclaw are an excellent candidate for subsistence and commercial aquaculture in PNG.

Acknowledgements

I thank Peter Graham and Brett Herbert for all the guidance and assistance in setting up and executing this experiment; Dave Bully for building the escape-proof cages; and Clive Jones for help in the statistics. This study was done during the tenure of a fellowship awarded to the author by the ATSE Crawford Fund.

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