Alternative Feeds for Nile tilapia (*Oreochromis niloticus*) in an Aquaponics System

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**Introduction**

Aquaculture, the farming of aquatic organisms including fish and aquatic plants, is an alternative solution to reduce global reliance on wild fisheries. The rise in global population and demand for consumable fish has put more stress on existing fish stocks. The practice of farming fish in a logical alternative that would relieve much of the stress on global fisheries. Naylor, et al. (2000) states that the long term growth of the aquaculture industry requires both ecologically sound practices and sustainable resource management. One of the most important problems facing aquaculture is the use of commercial feed, which is made up of fishmeal and fish oil. It is detrimental for the sustainability of aquaculture because it relies on wild fish stocks in order to feed farmed fish.

The aquaponics system at Cape Eleuthera Institute (CEI) is the symbiotic cultivation of plants and aquatic animals in a re-circulating system. By combining aquaculture and hydroponics, nutrient-rich wastewater from the fish tanks is circulated into the plant grow beds, which, in turn, send filtered oxygenated water back to the tanks. Currently the Tilapia in our system are being fed commercial feed containing fish meal and oil. The food is imported from Burris Specialty Feeds in Louisiana, which is a subsidiary of Cargill Incorporated.

The purpose of our study is to identify a locally grown, sustainable feed for the farming of Nile Tilapia (*Oreochromis niloticus*) in an aquaponics system.

We hypothesize that if we feed *O. niloticus* with locally-grown plant-based feed sources, then their growth rates will meet or exceed current growth rates exhibited with commercial feed.

**Methods**

The integrated aquaponics system combined the elements of aquaculture and hydroponics. The aquaponics system was composed of 12 buckets to test four treatments with two replicates. Each bucket had 30 Nile tilapia fingerlings totaling 120 fish with an initial weight of 15 ± 0.56 g (mean ± standard deviation). The wastewater from the fish was filtered through a biofilter and lettuce bed, then into the duckweed trough. From there, the water was pumped back through the sump into the buckets. The daily parameters measured were temperature (°C), dissolved oxygen (mg/L) and pH levels. Ammonia-nitrate levels were taken weekly. Each week all fish were removed to be weighed. These weights were used to calculate a mean weight and standard deviation.

Duckweed was collected from a trough as part of the integrated aquaponics system and was subsequently dried, ground into a powder to emulate the texture of the commercial fingerling feed. Duckweed has a protein content of 33-38% (Tawees et al. 2008), in comparison to that of the commercial feed (Burris 35%).

The periphyton for this study naturally grows in waste water flowing into the mangrove adjacent to the citrus hatchery of Cape Eleuthera Institute. It was collected from rocks, rinsed, dried, ground into powder, and fed to the fish. Periphyton has a protein content of 12-30% (Vandamme et al. 2002).

The four treatments were commercial feed (control), 50:50 duckweed:commercial, 50:50 periphyton:commercial, 50:50 periphyton:duckweed.

**Results**

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**Discussion**

In support of our hypothesis, the trial fish showed no significant difference in growth rates when compared with commercial feed and duckweed. The two treatments fed duckweed, however, yielded less successful results, likely due to information by Huchette and Beveridge (2005) stating that the nutritional content of periphyton is based on the substrate that it is grown on. The success of duckweed has demonstrated that the Island School can lessen their reliance on imported feed containing substantial amounts of wild fish oil and meal, thus reducing our dependence on wild fisheries.

A contradiction found in our data was that the fish fed commercial periphyton, suffered high mortality rates. However, the fish fed periphyton:duckweed had far fewer mortalities. Huchette and Beveridge (2003) found that fish fed solely periphyton had significantly lower growth rates than those that were given supplementary feed, which potentially explains the low growth rates of the fish fed periphyton duckweed. The reasons for the high mortalities of the fish fed commercial periphyton are unknown, as the parameters, feed, and fish health stayed regular. The large amount of finely ground periphyton discovered in the necropsy suggests that more research must be conducted to find better feeding practices. Additional research can also investigate the nutritional makeup and value for periphyton specifically grown in CEI’s mangrove when grown on different substrates, as explored by Huchette and Beveridge (2003).

Duckweed as a feed could potentially sustain other types of herbivorous or omnivorous fish in an aquaculture or aquaponics system. CEI now has the ability to produce tilapia in a more sustainable way, creating a closed system with fewer imports. A substantial amount of duckweed would be needed to sustain an aquaponics system the size of CEI’s. Further opportunities for experimentation involving the use of duckweed needed for an operation such as ours. This research should experiment with conditions needed to grow duckweed best, whether it is specific environmental parameters, surface area requirements and/or fertilizer sources.

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**References**


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