Optimizing Growth Performance of Climbing Perch, *Anabas Testudineus* in Aquaponics System with Recycled Materials and Upcycled Items

S. N. F. Zakaria[1] *& C. A. Chen[2]

[1]Department of Agrotechnology and Bio Industry, Politeknik Jeli Kelantan, 17600 Jeli, Kelantan.

[2] Borneo Marine Research Institute, Universiti Malaysia Sabah 88400 Kota Kinabalu, Sabah.

*Corresponding Author's Email: fatihah@pjk.edu.my

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Abstract

The present study showed the aquaponics system using the recycled material and upcycled items that many breeders can apply and besides, it can save the resources when cultured the climbing perch, Anabas testudineus in the system. The aim of the present study was to implement an aquaponics system utilizing recycled materials and upcycled items, and to assess the growth performance of climbing perch and water spinach, Ipomoea aquatica. There were 40 individuals for climbing perch were used during the experiment for 21 days. There were two treatments in the present study; control (without aquaponics) and treatment (with aquaponics) and each treatment has 20 individuals of climbing perch. For every 7 days, body weight (BW), body length (BL) and length of water spinach were measured. In addition, the survival (%) of climbing perch was also measured. The result showed the body weight (BW) and body length (BL) of climbing perch and length of water spinach were increased when cultured in aquaponics system after 21 days. In the present study, the survival (%) of climbing perch was 100 % for all treatments. As a conclusion, it is possible to ensure the present study was suitable by using the recycled materials and upcycled items. Moreover, both climbing perch and water spinach demonstrated suitability and positive outcomes in present study. This underscores the viability and safety of utilizing recycled materials in aquaponics systems, particularly for breeding enthusiasts seeking profitable results.

Keywords: *Anabas Testudineus*; Aquaponics System; Body Weight; Body Length; Survival.

1.0 Introduction

Aquaponics is the combination of Recirculatory Aquaculture System (RAS) and hydroponics system (Fadhilah et al., 2019; Fatihah and Cheng-Ann, 2022) and is generally concern from researchers and fish culturist as a result of its high ecological and monetary advantages (Anatharaja et al., 2017). Besides, from the previous by Fatihah and Cheng-Ann (2022) showed the culture of Cherax quadricarinatus with Pak Choi, Brassica rapa chinensis in aquaponics system for 28 days. Climbing perch (Anabas testudineus) of the family Anabantidae also popularly well-known as 'Koi' in India is a small sized food fish, which occupies both freshwater and brackish water (Borah et al., 2020) and being abundant in different parts of Asia; Bangladesh, China, India, Malaysia, Myanmar, Pakistan, Philipines, Sri Lanka and Thailand (Rahman, 2018; Khatun et al., 2019).

Climbing perch is a delicious, high-value fish species and it has accessory respiratory organs that could be cultured at high stocking density (Anantharaja et al., 2017). Hence, this fish has effectiveness as a fish target for aquaculture (Muchlisin, 2013; Putra et al., 2016). Study by Anantharaja et al. (2017), the growth and survival of climbing perch in a newly developed Nutrient Film Technique (NFT) aquaponics system was conducted for six weeks. In addition, the previous study by Syarifudin et al. (2023) used NFT in aquaponics that the system favoured by Indonesian aquaculturists and cultured the climbing perch in closed aquaponics system.

The primary challenges addressed in this study include the high costs and extensive material requirements associated with aquaponics operations. Materials such as tanks, pumps, PVC pipes, water filters and plant places are among the main tools and materials in aquaponics. Equipment such as filters, garden and pond places are often built on their own as the cost of these tools and materials increases due to the high demand. Thus, the present study was used the recycled material and upcycled items. In addition, this study emphasizes the development of recycled aquaponics systems constructed entirely from waste materials and used goods, minimizing costs. The system operates efficiently using low voltage water pumps. Therefore, the goals of the present study were to conduct the aquaponics system with the recycled material and upcycled items and; to determine the growth performance in climbing perch and water spinach (Ipomoea aquatica).

2.0 Methodology

The experiment was conducted at Fish Propagation (FPH), Politeknik Jeli Kelantan. The sample that carried out in the experiment was climbing perch and the water spinach. In the present study, a total of 40 individuals for climbing perch were used during the experiment for 21 days. Prior to commencing the experiment, the aquaponics system was carefully crafted using recycled materials and upcycled items. All tools and materials were prepared and after settle to set up the systems, climbing perch and water spinach were put in the aquaponics system. By using the bottles, the holes were made to place the sponge and the seed of water spinach were put in the bottles. For connection between the bottles, the piping was done that attached as a channel between the bottles. After that, climbing perch was put in the tank that installed the aquaponics system. The tank was filled with the water to test the aquaponics system.

There were two treatments in the present study; control (without aquaponics) and treatment (with aquaponics) and each treatment has 20 individuals of climbing perch. The body weight (BW) and body length (BL) of climbing perch in the present study were 0.60 ± 0.11 g and 11.74 ± 0.61 g. Both treatments were cultured in fiber tanks. In the present study, water spinach was used as a plant in the aquaponics system. Climbing perch were cultured in both treatments for 21 days and for every day, A. testudineus were fed with freshwater fish feed (Brand Cargill) (0.55 mm) for twice a day in the morning (8-9 am) and evening (5-6 pm). Besides, for every 7 days, BW, BL and length of water spinach were measured.

In addition, the survival of A. testudineus was also measured using the formula:

$$\text{Survival (\%)} = (\text{Final no. of A. testudineus} / \text{Initial no. of A. testudineus}) \times 100\ \%$$

3.0 Results and Discussion

The body weight of climbing perch increased significantly by day 21, rising from 0.64 ± 0.11 g to 1.08 ± 0.17 g, compared to the control group (Figure 1). While, body length (cm) for climbing perch was also increased until day 21 compared to the control from 11.62 ± 0.60 cm to 14.18 ± 0.50 cm (Figure 2). For survival rate (100 %), all treatments (without aquaponics and with aquaponics) were surviving (100 %) after cultured for day 21. Besides, leaves of water spinach in aquaponics system was increased from 72 to 131 leaves (Figure 3).

Anantharaja et al. (2017) and Syarifudin et al. (2023) reported successful growth and survival of climbing perch in a nutrient film technique (NFT) aquaponics systemThe study showed the daily weight gain (DWG), feed conversion ratio (FCR) and survival of fish grown in the aquaponics system were better than the fishes in control tank (without NFT aquaponics system) (Anantharaja et al., 2017). The present study showed the growth performance of climbing perch using aquaponics system with the recycled material and upcycled items. The plant that used in the present study was water spinach.

Environmental factors use an immense effect on the maintenance of a healthy aquatic environment and production of food organism (Hossain et al., 2012). Thus, the present study cultured the climbing perch in aquaponics system to maintain and enhance the healthy aquatic environment for the fish and plant. When cultured the climbing perch in aquaponics system, it can improve the survival rate and also body weight of climbing perch. It showed that there were increasing in body weight rather cultured without aquaponics system.

According to Putra et al. (2016), climbing perch are predominantly sourced from the wild due to the limited development of culture systems. Therefore, the present study cultured the climbing perch using aquaponics system with the recycled material and upcycled items. It is because the system can save the cost if the farmers want to enhance the culturing for climbing perch. Study by Ariffin et al. (2022) showed the climbing perch and; lettuce and Pak Choi plants were added after finalizing the fabrication process and climbing perch and plants were cultured for two weeks.

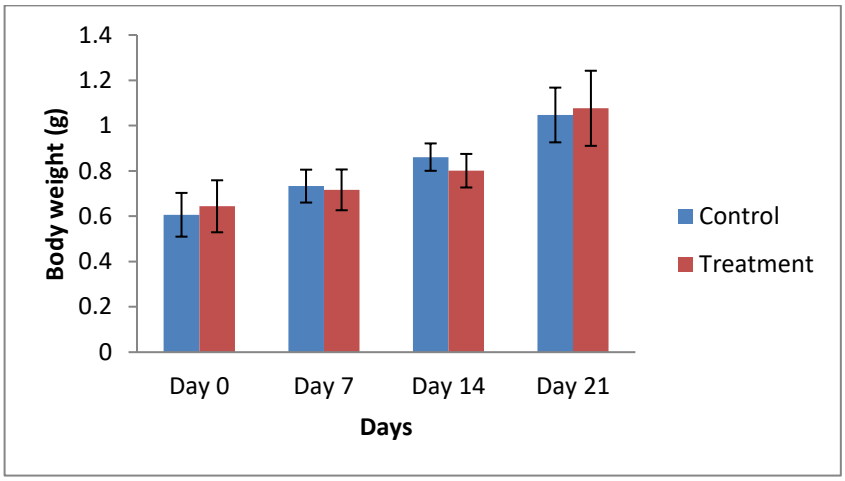

Figure 1: Body Weight (G) For Climbing Perch, *Anabas Testudineus* Until Day 21 For Control (Without Aquaponics) And Treatment (With Aquaponics).

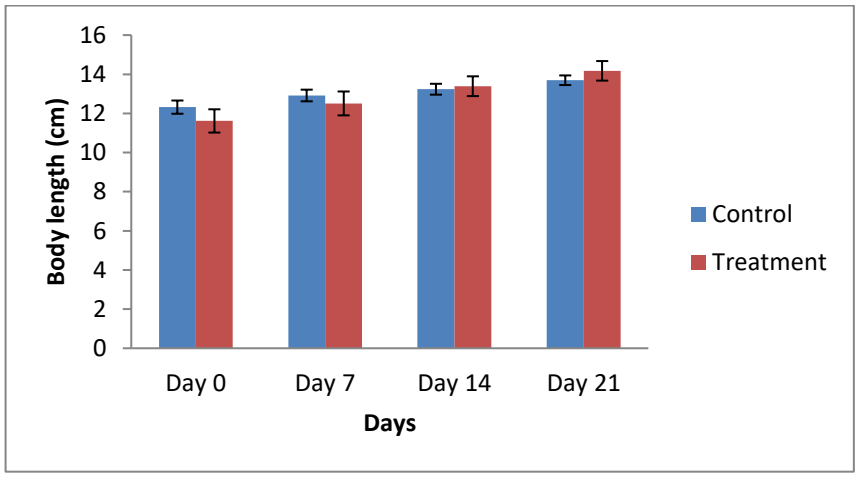

Figure 2: Body Length (Cm) For Climbing Perch, *Anabas Testudineus* Until Day 21 For Control (Without Aquaponics) And Treatment (With Aquaponics).

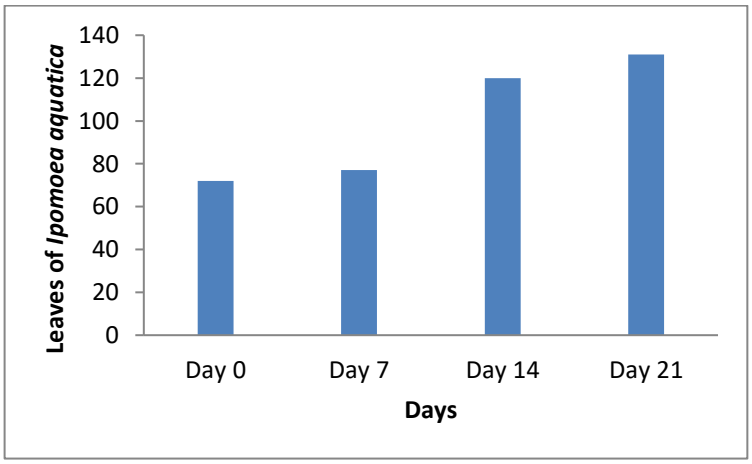

Figure 3: Leaves of Water Spinach, *Ipomoea Aquatica* in Aquaponics System Until Day 21.

4.0 Conclusion

In conclusion, this study demonstrated that utilizing recycled materials in aquaponics systems significantly reduces costs and can have a positive impact, particularly for communities seeking to enhance income generation. Moreover, the study has demonstrated that farmed fish and plants are well-suited and yield satisfactory results, enabling simultaneous cultivation of both fish and plants. This proves that the recycled aquaponics system as the main material for fish aquaponics system is suitable to use and safe especially to the breeding enthusiasts who get lucrative results. Besides, this study highlights the numerous societal and environmental benefits of recycling practices. By mitigating waste accumulation on land, in rivers, and in oceans, these practices play a critical role in preventing environmental pollution. With the aquaponics system project using recycled materials can make the community aware of the importance of recycling practices and how easy it is to earn side income. Water flow can supply oxygen to fish. This can maintain the quality of plants and livestock. Finally, the benefits of recycling as well as the quality of livestock and plants can help the community get inspired in recycling to add economic resources wisely.

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Author Contributions

S. N. F. Zakaria: Methodology. Conceptualisation, Formal Analysis and Writing Draft Preparation, Editing; **C. A. Chen:** Writing-Reviewing and Editing

Conflicts of Interest

The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its Submission and declare no conflict of interest in the manuscript.

References

Anantharaja, K., Mohapatra, B. C., Pillai, B. R., Kumar, R., Devaraj, C. & Majhi, D. (2017). Growth and survival of climbing perch, Anabas testudineus in Nutrient Film Technique (NFT) aquaponics system. *International journal of fisheries and aquatic studies* 5(4): 24-29. https://www.fisheriesjournal.com/archives/2017/vol5issue4/PartA/5-3-70-947.pdf

Ariffin, M. Z. M., Leman, A. M. & Rahman, K. A. (2022). The design and development of aquaponics piping system for urban farming. *Progress in Engineering Application and Technology* 3(1): 1017-1030.

Borah, A. K., Thakuria, J., Debnath, D. & Nath, D. (2020). Performance of Indian and Vietnamese strain of *Anabas testidineus* under captive condition in the Lower Brahmaputra Valley Zone of Assam. *Journal of Krishi Vigyan*: 236-243. DOI:10.5958/2349-4433.2020.00111.7

Fadhilah, N., Estim, A. & Fatihah, S. N. (2019). Water quality and growth performance of giant freshwater prawn, *Macrobrahium rosenbergii* and green bean, *Phaseolus vulgaris* in aquaponics system at different flow rates. *Transactions on Science and Technology* 6(1): 1-8. https://tost.unise.org/pdfs/vol6/no1/6x1x1-8.pdf

Fatihah, S. N. & Cheng-Ann, C. (2022). Determine the growth performance of redclaw, *Cherax quadricarinatus* in aquaponics system. *Politeknik & Kolej Komuniti Journal of Social Sciences and Humanities* 7(1): 96-102.https://myjms.mohe.gov.my/index.php/PMJSSH/article/view/20600

Hossain, M. S., Das, N. G., Sarker, S. & Rahaman, M. Z. (2012). Fish diversity and habitat relationship with environmental variables at Meghna river estuary, Bangladesh. Egyptian Journal of Aquatic Research 38 (3): 213-226.

Khatun, D., Hossain, M. Y., Nawer, F., Mostafa, A. A. & Al-Askar, A. A. (2019). Reproduction of *Eutropiichthys vacha* (Schilbeidae) in the Ganges River (NW Bangladesh) with special reference to potential influence of climate variability. *Environment Science and Pollution Research* 26:10800-10815. Doi: 10.1007/s11356-019-04523-5.

Muchlisin Z. A. (2013). Potency of freshwater fishes in Aceh waters as a basis for aquaculture and conservation development programs. *Jurnal Iktiologi Indonesia* 13(1):91-96. DOI: 10.32491/jii. v13i1.115

Putra, D. F., Fanni, M., Muchlisin, Z. A., Muhammadar, A. A. (2016). Growth performance and survival rate of climbing perch (*Anabas testudineus*) fed Daphia sp. enriched with manure, coconut dregs flour and soybean meal. *AACL Bioflux* 9(5): 944-948. http://www.bioflux.com.ro/docs/2016.944-948.pdf

Rahman, M. M., Hossain, M. Y., Jewel, M. A. S., Billah, M. M. and Ohtomi, J. (2018). Population biology of the pool barb Puntius sophore (Hamilton 1822) (Cyprinidae) in the Padma River, Bangladesh. *Zoology and Ecology* 28: 100-108. https://doi.org/10.1080/01694243.2018.1464703

Syarifudin, A. A., Prayogo, Suciyono, Kenconojati, H., Santanumurti, M. B., Lamadi, A. & Jati, C. W. (2023). Performance of climbing perch (Anabas testudineus) and Bok Choy (Brassica chinensis) in aquaponics systems using nutrient film technique in Indonesian small-scale livestock. *Pertanika Journal of Tropical Agricultural Science* 46(4): 1375-1390. https://doi.org/10.47836/pjtas.46.4.19