Comparison Study of Water Quality and Organoleptic Analysis of Catfish (*Clarias* sp.) From Conventional Pond and Aquaponic Systems

Ferriawan Yudhanto[1*], *Rinasa Agistya* Anugrah[1], *Ade Utari* Triwijayani[2], *Ogah Anselm* Ogah[3], *Mamdouh Ahmed* Omar[4]

[1]Department of Automotive Engineering Technology, Universitas Muhammadiyah Yogyakarta, 55183, Indonesia
[2]Department of Aquaculture, Akademi Perikanan Yogyakarta, 55165, Indonesia
[3]Department of Polymer Engineering, Nnamdi Azikiwe University, Awka, Nigeria
[4]Department of Dairy, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt

Abstract. Catfish is one of the most popular in Indonesia because it is easy to maintain. Catfish can be cultured in ponds or together with plants, known as an aquaponic system. This study aimed to compare water quality and the quality of catfish cultured using conventional systems in concrete ponds and an aquaponic systems in plastic fiber ponds. This study has the results of water quality testing showing a difference in the ammonia value of 3 ppm in concrete pond using conventional system and 0.5 ppm in plastic fiber ponds using an aquaponic system. Meanwhile, the results of organoleptic test show that catfish cultured using an aquaponic system provide higher value comparison to the conventional system. Catfish cultured with an aquaponic system is better than conventional systems in ponds.

1 Introduction

Catfish are known as fish that are easy to cultivate in ponds and rivers using cages. The pond commonly used by the community are permanent and non-permanent pools. Cultivating catfish in non-permanent ponds uses tarpaulin material, which is in great demand by the public because it can be placed in narrow areas and various pond sizes. This type of pool has the potential to be used in narrow areas, which are often found in urban areas. The advantages of using tarpaulin ponds for cultivating catfish are that they are cheap and easy to apply because they are made from composite plastic. Catfish will grow big and fast, influenced by food and water quality. The water quality in catfish farming ponds will easily change, with the water becoming muddy and smelling bad due to the high ammonia content caused by fish waste and leftover feed that settles at the bottom of the pond, and causes stink, disturbs the environment of people whose houses are nearby.

Corresponding author : ferriawan@umy.ac.id

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

One way that can be done to manage conventional pond so that it does not change easily is by implementing a recirculation system in the pond by adding plants as biofilters [1]. Combining plants as biofilters and fish farming is an aquaponics system. Plants will absorb nutrients in the form of nitrates and nitrites, which trigger the formation of ammonia from food and fish waste. Aquaponic systems are divided into 6, namely wick system [2], water culture system, drip irrigation system, aeroponic system [3], ebb and flow system [4], nutrient film technique (NFT) [5]. One way that can be done to manage water in pond so that it does not change easily is by implementing a recirculation system in the pond by adding plants as biofilters [6]. Combining plants as biofilters and fish farming is an aquaponics system. Plants will absorb nutrients in the form of nitrates and nitrites, which trigger the formation of ammonia from food and fish waste. Aquaponic are divided into six systems, namely the wick system [2], water culture system [6], drip irrigation system [7, 8], aeroponic system [9, 10], ebb and flow system [11, 12], nutrient film technique (NFT) [5, 13]). This research aims to compare the water quality and quality of catfish with organoleptic tests cultivated in permanent ponds without an aquaponics system and non-permanent ponds using composite plastic ponds and the aquaponics method. This research aims to compare the water quality of catfish with organoleptic tests cultivated in permanent ponds without an aquaponics system and non-permanent ponds using composite plastic ponds and the aquaponics method.

2 Material and Method

This research uses a method consisting of observation, interviews and purposive sampling. The catfish used from Budi Fish Farm (Donoharjo, Ngaglik, Sleman, Yogyakarta, Indonesia), which is cultured in concrete pond using a conventional system and Wana-Wana Akuaponik (Sardonoharjo, Ngaglik, Sleman, Yogyakarta, Indonesia) cultured in plastic fiber ponds using an aquaponic system.

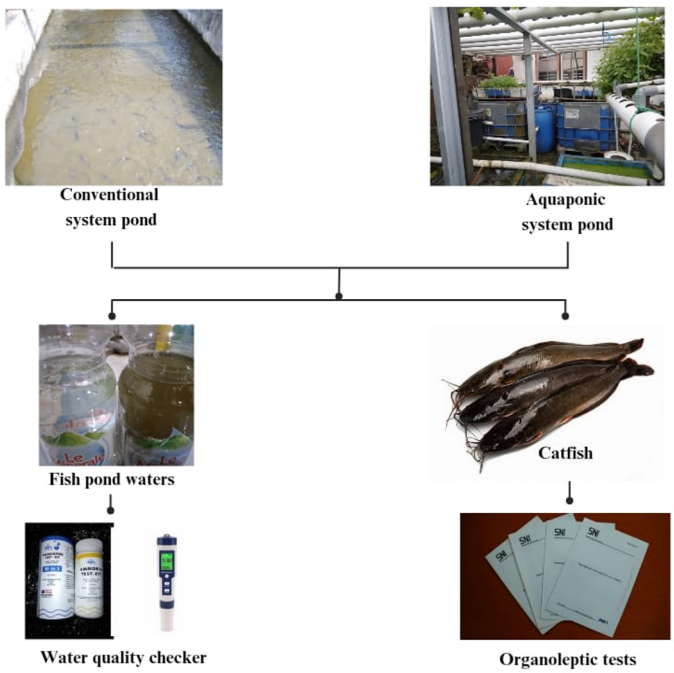


Fig. 1. The scheme of comparison water quality and organoleptic analysis of catfish

Three fish were used from each pond with a weight ranging from 50-250 g. The data collected consisting of water quality and the quality of catfish use organoleptic test. Water quality was checked using a thermometer, Aquaculture, digital pH and Ammonia Fis-TX test-kit type. The parameters observed consisted of pH, temperature, nitrate values, ammonia values and water color. The quality of catfish used organoleptic tests according to SNI 2729:2013 to Fresh Fish [14]. The parameters were appearance (eyes, gills, and body surface mucus), flesh, odor and texture. The data was analyzed descriptively and compared with the appropriateness value of water quality in catfish cultured and the quality of fresh catfish.

3 Result and discussion

3.1 Water Quality

The key to successful catfish farming activities is properly managing pond water quality. It is closely related to the catfish growth. Water quality, including temperature, pH, ammonia, nitrate, nitrite, and water colour are important factor to significant impact to quality of catfish.

Table 1. The results of water quality

System of Ponds	Parameters					
	Temp. (°C)	pH	Nitrate (NO_3) Value (mg/L)	Nitrite (NO_2) value (mg/L)	Ammonia value (mg/L)	Water color
Conventional	29.6	7.8	25	0.1	3	Green
Aquaponic	25.7	7.1	10	0.1	0.5	Transparant

Based on the observation results in Table 1, the average temperature obtained can be shown that the results of 29.6°C in conventional and 25.7°C in aquaponic pond systems. The optimum temperature for catfish rearing cultivation activities is 25-30°C [15]. Temperatures that are less than optimal will cause the catfish's appetite to decrease so that growth becomes slower. The pool water temperature rises and falls quickly due to the type of pool (concrete pond, tarpaulin pond, soil pond, and semi-permanent). The pool needs to be covered with a cover in the form of a plastic layer so that it prevents rainfall from entering and sunlight can still enter the pool. The rain causes the ideal pH for cultivating catfish is 6.5-7.5 [16, 17]. The results of measurements in aquaponic ponds are still within safe limits for growing catfish, while catfish in conventional ponds are in the alkaline category. Ponds with alkaline water levels stress fish and disrupt their growth, while low pH (acid) causes catfish to become lazy and slimy and can cause death [18, 19]; another value measured is Nitrate and Ammonia values. The nitrate value in conventional pond water is higher (25 mg/L) than aquaponic system pond (10 mg/L), which uses water circulation into a settling pond connecting to a paragon pipe containing hydroponic plants. The ammonia value from conventional pond systems shows high results, namely three (3) mg/L, which can be dangerous [20]. This can happen because uneaten food and fish waste that settles at the bottom of the pond are not removed regularly, affecting the pond water's colour, which looks a bit dark greenish. Conventional pond requires regular water changes, while aquaponic pool systems do not need water changes.

3.2 The Quality of Catfish

Fish growth can be seen from the quality of the pond water and the fish's quality, which can be examined directly or microscopically. Before further examination, the catfish were measured based on weight and length, as in Table 2. The catfish used from the two ponds were in different conditions, so the size and weight obtained were more significant than those from the aquaponic system pond.

Table 2. Weight and length of catfish

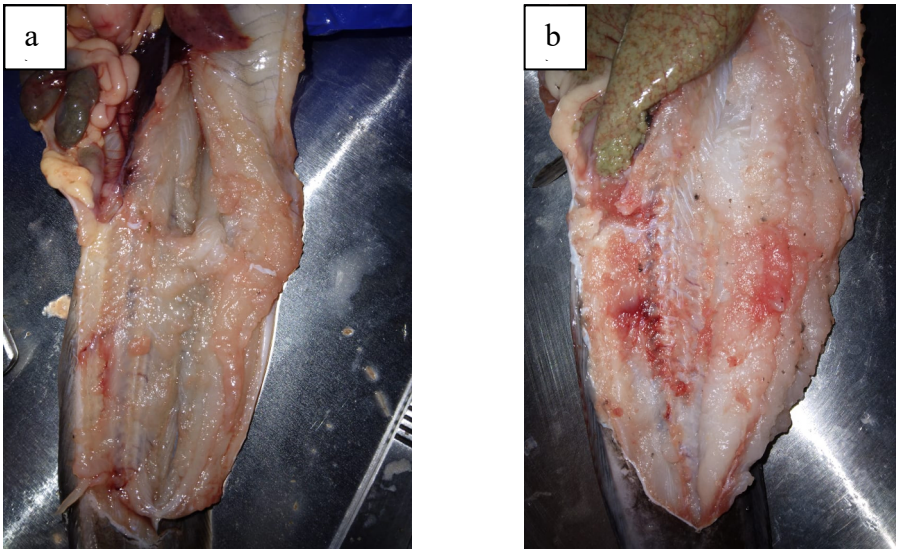
System of Ponds	Characteristics	
	Weight (g)	**Length (cm)**
Conventional	59 – 70	19.5-20.5
Aquaponic	199 - 236	29-30

The quality of fish can be seen in one way: by carrying out organoleptic tests. Organoleptic tests were carried out on ten selected respondents. This test is carried out by assessing with a range of 1 – 9 according to the characteristics of the condition of the fish in the specifications listed on the worksheet, which consists of appearance (eyes, gills and body surface mucus), and flesh such as smell and texture, especially for fresh fish.

Table 3. The results of organoleptic tests fresh catfish SNI 2729:2013

No.	Specification	System of Ponds	
		Conventional	**Aquaponic**
1.	**Appearance**		
a.	Eyes	7.7	9
b.	Gills	7.7	9
c.	Body Surface Mucus	8	9
2.	**Flesh**		
a.	Smell	8	9
b.	Texture	8	9
Average		**7.9**	**9**

Table 3 shows that the organoleptic value of fresh catfish obtained from conventional system ponds and aquaponic systems is still acceptable when fresh which range 7-9. However, the test scores for catfish from aquaponic ponds are better than those from conventional ones; this shows that water quality greatly influences the quality of the flesh. According to Sipahutar et al. [21], catfish in living conditions produce an organoleptic value of 9. According to Bernard et al. [22], fish flesh is the part of the fish that is easily damaged due to intrinsic and extrinsic factors. It is related to the fish's survival time of only 5-8 hours in the open air. The catfish flesh in Figure 2 looks quite different because the fish obtained from farmers have different ages. Catfish that come from aquaponic system ponds look whiter, brighter and thicker when compared to catfish that come from conventional system ponds.



Split Catfish meat from; a) conventional pond, b) Aquaponic system

Fig. 2. Comparison flesh of catfish from different ponds

4 Conclusions

The results of water quality and organoleptic test showing of catfish using aquaponic system pond is better than conventional system in concrete pond. The Aquaponic system can sustainably control water quality according to the characteristics of catfish development so that good fish results are obtained in taste and thicker flesh.

Acknowledgement

The authors would like to thank Universitas Muhammadiyah Yogyakarta through LPM for providing funds to support this research.

References

1. Setijaningsih, L. dan L.H. Suryaningrum. Berita Biologi. **14**(3): 287-293. (2015)
2. Lee, C. W., I. S. So., S. W. Jeong., dan M. R. Huh. Journal of Agriculture&Life Science **44**(3) pp.7-14. (2010).
3. Kurniawan, A., E. Asriani, dan S.P. Sari. *Buku Ajar: Bioflok dan Akuaponik untuk Bangka Belitung.* Malang. Media Nusa Creative. (2018)
4. Daud, M., Handika, V., & Bintoro, A. International Journal of Scientific and Technology Research, **7**(9), 138-144. (2018)
5. Puerta, A. R., Sato, S., Shinohara, Y., & Maruo, T. HortTechnology, **17**(2), 227-233. (2007)
6. Turcious A. E., & Papenbrock, J. Sustainability, **6**(2), 836-856. (2014)
7. Agrawal, N., & Singhal, S. Smart drip irrigation system using raspberry pi and arduino. In *International Conference on Computing, Communication & Automation* (pp. 928-932). IEEE. (2015)

8. Maisiri, N., Senzanje, A., Rockstrom, J., & Twomlow, S. J. Physics and Chemistry of the Earth, parts A/B/C, **30**(11-16), 783-791. (2005)
9. Lakhiar, I. A., Jianmin, G., Syed, T. N., Chandio, F. A., Buttar, N. A., & Qureshi, W. A. Journal of sensors (1), 8672769. (2018)
10. Mithunesh, P., Gupta, K., Ghule, S., & Hule, S. IOSR Journal of Computer Engineering (IOSR-JCE), **17**(6), 55-58. (2015)
11. Jani, A. D., Meadows, T. D., Eckman, M. A., & Ferrarezi, R. S. Agricultural Water Management, **246**, 106711. (2021)
12. Wortman, S. E. Scientia Horticulturae, **194**, 34-42. (2015)
13. Alipio, M. I., Cruz, A. E. M. D., Doria, J. D. A., & Fruto, R. M. S. Engineering in Agriculture, Environment and Food, **12**(3), 315-324. (2019)
14. Nasional, B. S. Standar Nasional Indonesia Tentang Abon Ikan-Bagian 3: Penanganan dan Pengolahan. (SNI-7690.3: 2013). *BSN. Jakarta*. (2013)
15. Rem, P., Chiayvareesajja, S., & Suanyuk, N. Songklanakarin Journal of Science and Technology, **42**(6), 1253-1258. (2020)
16. Suraya, U., Gumiri, S., & Permata, D. D. Journal of Tropical Fisheries, **16**(2), 109-115. (2021)
17. Adewolu, M. A., Ogunsanmi, A. O., & Yunusa, A. European Journal of Scientific Research, **23**(2), 252-260. (2008)
18. Marimuthu, K., Palaniandya, H., & Muchlisin, Z. A. Aceh Journal of Animal Science, **4**(2), 80-88. (2019)
19. Irfan, I. S. S., & Ginting, J. Journal of Technomaterial Physics, **4**(2), 122-128. (2022)
20. Makori, A. J., Abuom, P. O., Kapiyo, R., Anyona, D. N., & Dida, G. O. Fisheries and Aquatic Sciences, **20**, 1-10. (2017)
21. Sipahutar, Y.H., Napitupulu, R. J., & Susanto, W. P. Pengaruh Penambahan Kentang Solanum Tuberosum Terhadap Mutu Kesukaan Konsumen Abon Lele Kremes. In Seminar Nasional Kelautan XII, Fakutas Teknik Dan Ilmu Kelautan Universitas Hang Tuah, Surabaya 20 JUli 2017, 89–98. (2017)
22. Bernard, E., Bankole, N. O., Akande, G. R., Adeyemi, S., & Ayo-Olalusi, C. I. Internet Journal of Food Safety, **12**: 62-70. (2010)