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ANALYSIS OF WATER QUALITY IN ORNAMENTAL FISH FARMING GROUPS (POKDAKAN) IN PANGKALPINANG CITY

ANALISIS KUALITAS AIR BUDIDAYA IKAN HIAS PADA KELOMPOK PEMBUDIAYA IKAN (POKDAKAN) DI KOTA PANGKALPINANG

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Abstract

Water quality is an important factor affecting the success of ornamental fish cultivation, especially in small cultivation containers with high density. The objective of this study was to evaluate the quality of water in ornamental fish cultivation ponds in five Fish Cultivation Groups (Pokdakan) in the City of Pangkalpinang and compare it with the water quality standards of Class 2 as per Government Regulation Number 22 of 2021. Descriptive quantitative approach was employed in this study. Air samples from five Pokdakan (Cg Bukit Intan, Gerunggang Betta, Said FM Aquafish, Pangkalpinang Fancy Guppy and Adi Fish Farm) were analyzed at the UPTD Environment Laboratory of the DLHK Province of Bangka Belitung for parameters such as dissolved oxygen (DO), pH, temperature, ammonia and detergents (methylene blue active substances/MBAS). DO levels were in the range of 4.00–5.30 mg/L and met the quality standard (minimum 4 mg/L), but three locations were just at the minimum threshold. The pH values ranged from 4.90 to 6.57 and were below the quality standard (6–9) in three Pokdakan, with the lowest value observed in Pangkalpinang Fancy Guppy. The ammonia levels varied from 0.069 to 0.329 mg/L, and exceeded the quality standard (0.2 mg/L) at Said FM Aquafish, with a similar temperature of 29.6 °C. The detergent levels were within safe limits below 0.012 mg/L at all locations. Only one of the five Pokdakan, namely Adi Fish Farm, meets all quality standards on the parameters tested. Water quality improvement can be done by gradual pH adjustment, routine water exchange, feed management and increased aeration as well as water quality monitoring periodically.

Keywords: water quality, ornamental fish, culture group, pH, ammonia, Pangkalpinang

Abstrak

Kualitas Air merupakan salah satu faktor utama yang menentukan keberhasilan budidaya ikan terutama pada budi daya ikan dengan wadah budi daya yang kecil seperti pada ikan hias. Penelitian ini dilakukan untuk menganalisis kualitas air pada lima Pokdakan ikan hias di Kota Pangkalpinang. Hasil Uji kulitas air ini kemudian dibandingkan dengan standar baku mutu untuk budi daya ikan yaitu baku mutu air kelas 2 sesuai dengan Peraturan Pemerintah Nomor 22 tahun 2021. Penelitian ini dilakukan dengan metode deskriptif kuantitatif dengan menganalisa sampel air yang diperoleh dari lima Pokdakan ikan hias di Kota Pangkalpinang yaitu Pokdakan Cg Bukit Intan, Gerunggang Betta, Said FM Aquafish, Pangkalpinang Fancy Guppy dan Adi Fish Farm. Sampel Air tersebut kemudian diuji oleh UPTD Laboratorium Lingkungan Dinas Lingkungan Hidup dan Kehutanan (DLHK) Provinsi Kepulauan Bangka Belitung. Parameter yang diui meliputi oksigen terlarut (DO), pH, suhu, amonia dan deterjen (*methylene blue active subtances*/MBAS). Kadar DO berada pada kisaran 4.00-5.30 mg/L dan memenuhi baku mutu minimum 4 mg/L), tetapi pada tiga lokasi berada pada batas minimum baku mutu. Nilai pH bervariasi dari 4.90 samapai 6.57 dan tiga Pokdakan berada dibawah standar baku mutu (6-9), dengan nilai terendah di Pangkalpinang fancy Guppy. Level amonia bervariasi dari 0.069 sampai 0.329 mg/L dan tidak sesuai dengan standar baku mutu (0.2 mg/L) di Said FM Aquafish. Suhu pada semua Pokdakan adalah sama yaitu 29.6 °C. Level deterjen berada pada level yang aman yaitu dibawah 0.012 mg/L pada semua lokasi. Hanya satu Pokdakan yaitu Adi Fish Farm yang memenuhi standar baku mutu pada parameter yang diuji. Perbaikan kualitas air dapat dilakukan

dengan melakukan peningkatan pH secara bertahap, pergantian air secara berkala pengelolaan pakan, disertai pemantauan kualitas air secara berkala.

Kata Kunci: kualitas air, ikan hias, Pokdakan, pH, amonia, Pangkalpinan

INTRODUCTION

The cultivation of ornamental fish is developing on a household scale and among groups of breeders in urban areas, including the city of Pangkalpinang, generally using relatively small containers with high stocking densities. Under these conditions, the cultivation ponds are vulnerable to a decline in water quality due to pollutants originating from within the cultivation system, such as leftover feed and fish feces, as well as from outside the system, such as household and industrial waste (Mrozik *et al*.,2019).Water quality occupies a central position in the success of aquaculture because it directly affects the survival, growth, and metabolism of fish (Goi & Nasrul, 2025; Ahmad *et al.,* 2024). The physical and chemical parameters commonly monitored include dissolved oxygen (DO), pH, temperature, and ammonia (Verma *et al.,* 2022; Liang *et al.,* 2024). These parameters are interrelated. The pH and temperature values, for example, determine the proportion of un-ionized ammonia (NH_3) that is toxic to fish, and this proportion increases with rising pH and temperature (Emerson *et al.,* 1975).

In addition, detergents are one of the components of household waste that can have toxic effects on aquatic biota (Halang, 2018). The quality of the cultivation media water ideally meets the quality standards as regulated in Government Regulation Number 22 of 2021 concerning the Implementation of Environmental Protection and Management specifically Annex VI for water classes designed for fish cultivation(Government of the Republic of Indonesia, 2021). Suboptimal environmental conditions do not always cause direct death, but chronic exposure can reduce fish immunity and increase their susceptibility to diseases (Boyd, 2017). Therefore, monitoring water quality in fish farming groups (Pokdakan) becomes an important foundation for aquaculture management and the implementation of biosecurity (Subasinghe & Shinn, 2023).

Information regarding the water quality of ornamental fish breeding ponds at Pokdakan in Pangkalpinang City is still limited. This study aims to analyze the water quality of ornamental fish breeding ponds in five Pokdakan in Pangkalpinang City based on the parameters of DO, pH, temperature, ammonia, and detergent, and to compare it with quality standards to determine the necessary management steps.

MATERIALS AND METHODS

Research Location and Timing The study was carried out among five ornamental fish farming groups in Pangkalpinang City, Bangka Belitung Islands Province, specifically Cg Bukit Intan, Gerunggang Betta, Said FM Aquafish, Pangkalpinang Fancy Guppy, and Adi Fish Farm. Water sampling occurred on November 26, 2024. At each ornamental fish farmer groups, water was taken from the water source that supplies the aquarium used for rearing ornamental fish, using the grab sampling technique. Whereby each test parameter was measured on a sample taken from a single water source, following the sampling principles of SNI 8990:2021. For pH, dissolved oxygen (DO), and temperature, water was collected using a 10L bucket and measured directly on site (at the Pokdakan) to avoid changes in reading with two replicates. 1 L water sample was collected from same water source and placed in a polyethylene bottle for ammonia measurement and 500 ml water sample placed in a glass bottle for deterjen (MBAS) measurement. The examination of ammonia and deterjen (MBAS) took place at the UPTD Environmental Laboratory of the Department of Environment and Forestry, Bangka Belitung Islands Province, accredited by the National Accreditation Committee (KAN), employing standardized. Each sampling was analyzed in duplicate for each parameter, according to the methods listed in Table 1.

Data were examined through descriptive quantitative analysis by determining the range and mean of each parameter, subsequently juxtaposing them with the Class 2 water quality benchmarks outlined in Appendix VI of Government Regulation Number 22 of 2021, which stipulate a minimum dissolved oxygen of 4 mg/L, pH levels between 6 and 9, a temperature variation of 3 °C, ammonia concentration of 0.2 mg/L, and detergent (MBAS) at 0.2 mg/L. The proportion of un-ionized ammonia was calculated based on pH and temperature as per Emerson *et al.* (1975), presuming that the detected ammonia represents total ammonia.

RESULTS

3.1 Dissolved Oxygen (DO)

The DO levels in five Pokdakan range from 4.00 to 5.30 mg/L with an average of 4.46 mg/L. All locations meet the minimum quality standard

of 4 mg/L. However, three Pokdakan (Cg Bukit Intan, Said FM Aquafish, and Pangkalpinang Fancy Guppy) were recorded exactly at the lower threshold of 4.00 mg/L, whereas the highest level was found in Gerunggang Betta (5.30 mg/L) followed by Adi Fish Farm (5.00 mg/L) (Figure 1a).

3.2 Degree of Acidity (pH)

The pH values range from 4.90 to 6.57 with an average of 5.78. Three out of five Pokdakan are below the minimum quality standard, namely Pangkalpinang Fancy Guppy (4.90), Cg Bukit Intan (5.44), and Gerunggang Betta (5.51). The lowest pH value in Pangkalpinang Fancy Guppy is 1.10 units below the lower limit of the quality standard. Meanwhile, the Said FM Aquafish and Adi Fish Farm Pokdakan meet the quality standards, although their values are close to the lower limit (Figure 1b).

3.3 Temperature and Detergent

The water temperature was uniformly recorded at 29.6 °C across all Pokdakan. The detergent level (MBAS) at all locations is below 0.012 mg/L, far below the quality standard of 0.2 mg/L (Table 2).

3.4 Ammonia

The concentration of ammonia varies between 0.069 and 0.329 mg/L, with a mean value of 0.168 mg/L. The ammonia concentration exceeds the permissible limit at Said FM Aquafish (0.329 mg/L, about 1.6 times the quality standard)

The other four Pokdakan, namely Gerunggang Betta (0.162 mg/L), Pangkalpinang Fancy Guppy (0.154 mg/L), Adi Fish Farm (0.128 mg/L), and the lowest at Cg

Bukit Intan (0.069 mg/L), are still below the maximum threshold value (Figure 1c).

3.5 Recapitulation of Compliance with Quality Standards

Adi Fish Farm is the only Pokdakan that meets all quality standards for the tested parameters. The other four Pokdakan each have one parameter that does not meet the quality standards: pH in Cg Bukit Intan, Gerunggang Betta, and Pangkalpinang Fancy Guppy, and ammonia in Said FM Aquafish

Table 1. Parameters, Analysis Methods, and Standard References

Parameter	Unit	**Analysis Method**	**Standard Refferences**
DO (Dissolved Oxygen)	mg/L	Electrometer (DO meter)	SNI 06-6989.14-2004
pH	-	Electometer (pH meter)	SNI 06-6989.11-2019
Temperature	°C	Mercury Thermometer	SNI 06-6898. 23- 2005
Ammonia (NH_3-N)	mg/L	Spectrophotometry (Blue Indophenol method)	SNI 06-6989.30-2005
Deterjen (MBAS)	mg/L	Spectophotometry (Methylene Blue)	SNI 06-6989.51-2005

Table 2. Results of water quality analysis in ornamental fish farming ponds at five Pokdakan in Pangkalpinang City

Parameter	**Cg Bukit Intan**	**Gerunggang Betta**	**Said FM Aquafish**	**Pangkalpinang Fancy Guppy**	**Adi Fish Farm**	**Benchmark**
Temperature (°C)	29,6	29,6	29,6	29,6	29,6	Deviation 3
Deterjen–MBAS (mg/L)	<0,012	<0,012	<0,012	<0,012	<0,012	0,2

Note: bold numbers = do not meet quality standards (PP No. 22 of 2021, Class 2); temperature deviation from natural temperature. Calculated according to Emerson et al. (1975), assuming the measured ammonia is total ammonia.
Source: UPTD Environmental Laboratory DLHK Prov. Kep. Bangka Belitung, 2024

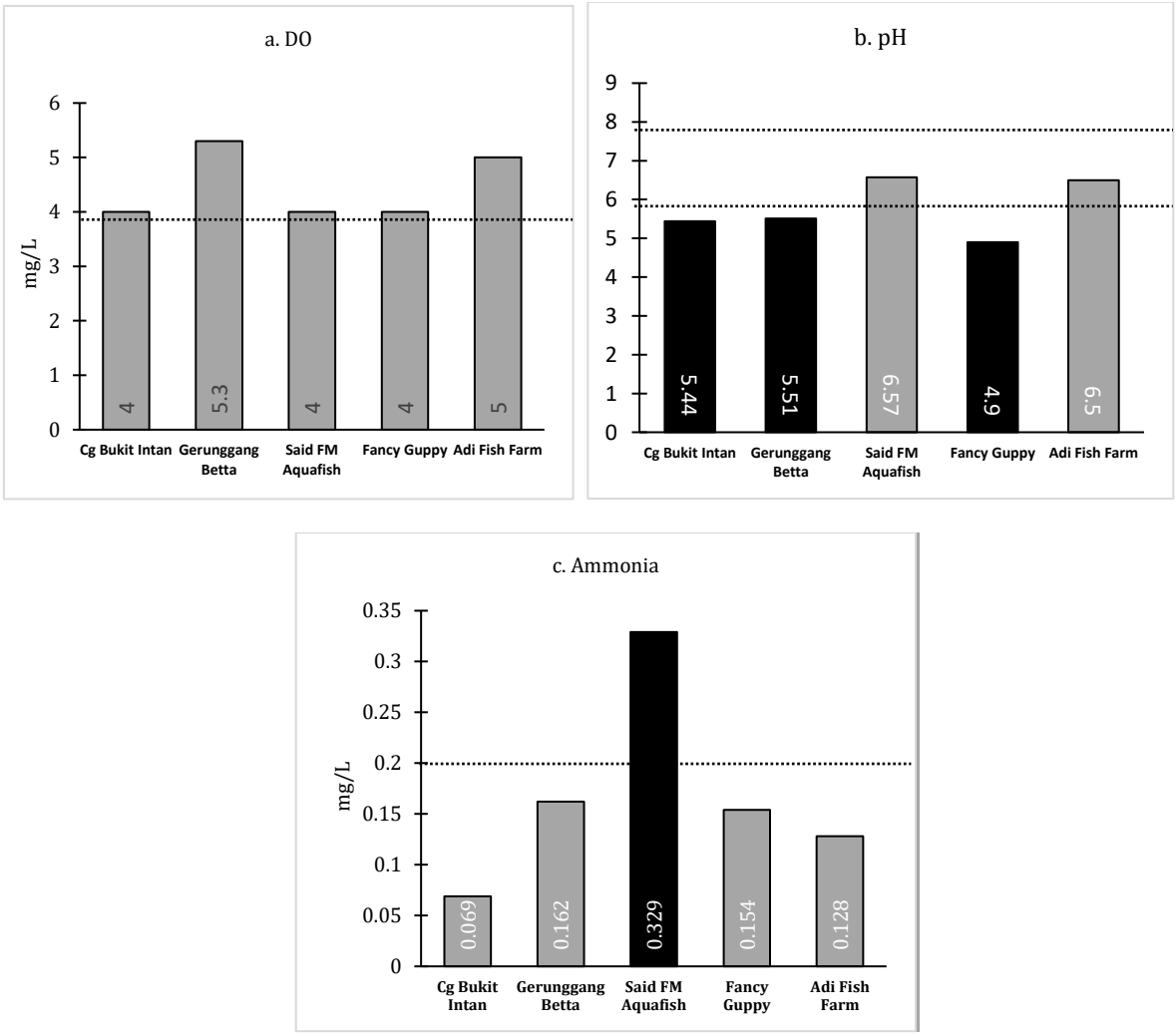


Figure 1. DO value (a), pH(b), and ammonia (c) in five ornamental fish Pokdakan. The dashed line indicates the quality standard (Class 2 , PP No. 22 of 2021) ;the dark bars indicate values that do not meet the quality standard.

DISCUSSION

The DO levels in all ornamental fish farmer groups tested are still within the ideal range for fish farming, although there are 3 groups with DO values at the minimal threshold (4 mg/L). At a temperature of 29.6 °C, the saturation solubility of oxygen in freshwater at sea level atmospheric pressure is around 7.6 mg/L (Boyd, 2020), so a DO of 4.00 mg/L is equivalent to about 53% saturation. This condition is suspected to be related to the characteristics of small-sized cultivation containers with high stocking density, while the rate of oxygen consumption by fish and the decomposition of organic matter occurs intensively (Verma *et al*., 2022). Generally, daily DO in fish farming usually fluctuates with the lowest values occurring in the early morning, so a single measurement has the potential to not represent the lowest conditions (Boyd, 2020). To prevent oxygen deficiency in fish farming, additional aeration, reduced stocking density, and controlled feeding need to be implemented, especially in fish farming groups that are at the minimum DO limit, namely Cg Bukit Intan, Said FM Aquafish, and Fancy Guppy.

Low pH is the main problem in ornamental fish farming groups in this study. In general, low pH in aquaculture ponds can originate from acidic water sources, as well as the accumulation of carbon dioxide from respiration and the decomposition of organic matter (Boyd, 2020). Low pH also causes stress and tissue damage, which alters blood parameters and increases susceptibility to bacterial infection (Sojitra *et al.,* 2024). Deviation of pH from the optimal range disrupts acid-base balance, damage ion regulation and trigger oxidative stress, which trigger the activation of Hypothalamic Pituitary Internal Axis and increasing of cortisol level, Inhibit the fish's immunological response, resulting in increased vulnerability to illness (Ding *et al.*, 2023; Yada *et al*., 2006). Low pH (acidic) water causes irritation and damage to

fish gill tissues, including hyperplasia (thickening or proliferation of cells in the gill epithelium), which disrupts the oxygen diffusion process and causes the fish to have difficulty breathing, ultimately leading to fish death (Firna & Pratama, 2026).

Each ornamental fish species has different pH tolerances, such as platies which are more stable in alkaline pH and barbs which are more resistant to acidic conditions (Srisaiprajwal Zutshi, 2024). Gold Fish thrive at pH 7-8, with lethal limits at pH 4 and 11 (Nasution *et al.*, 2020). Guppy ideal condition on pH 6.5-7.5 (Kusumaraga *et al*., 2021). Molly larvae survive at pH 5 but show significantly reduced growth compared to pH 6.9 (Tembo, 2024). Class 2 quality standards are general in nature, so pH requirements need to be evaluated according to the type of fish cultivated in each Pokdakan.

Three out of five pokdakan have low pH levels (Cg Bukit Intan, Gerunggang Beta, and Fancy Guppy), therefore pH management is necessary. pH regulation can be achieved as the incorporation of materials like gravel and sand substrates led to elevated pH levels and the by-products ammonia and nitrate (Vanderzwalmen *et al*., 2022). Improvement of pH values can be carried out gradually by adding lime (Mulyani & Rahmadani, 2025) or baking soda (sodium bicarbonate) to the cultivation containers must be accompanied with periodic pH measurements to prevent sudden pH changes (Mariana *et al*., 2020),

The ammonia levels in Said FM Aquafish that exceed the quality standards are suspected from the water source used, which is groundwater. Ammonia from urban groundwater is caused by the decomposition of organic matters (Ammonification) with potential sources being septic tank and leaking sewage (Linhart, 2001). Ammonia is the final byproduct of the metabolism of fish proteins and the breakdown of organic substances (Verma *et al.,* 2022), hence controlling feed, siphoning feces and leftover feed need to be maintain properly to prevent accumulation of ammonia. From a toxicity perspective, the risk of ammonia at low pH is relatively small because most ammonia is in the ionized form (NH_4+) which is less toxic (Yun *et al*., 2025). Even in low pH ammonia is less toxic, but in warm temperature fish metabolism and ammonia excretion are increase. Hence, ammonia toxicity tends to rise with increasing in temperature and pH as a bigger fraction of NH3 (Parvathy *et al.,* 2023). Compared to the others Pokdakan, Said FM Aquafish also has a higher pH. This will result in a higher potential for ammonia toxicity.

In ornamental fish such as guppies, elevated ammonia caused increased nervous behavior, oxidative stress and trigger inflammation. This behavioral effect is relevant to ornamental fish since stressed fish tend to become lethargic or withdraw themselves before to death (Zhang *et al.*, 2023). Goldfish have a more effective liver antioxidant system against ammonia compared to common carp, while trout are the weakest. This explains why goldfish are considered resilient with ammonia (Sinha *et al.*, 2014).

Optimal management of ammonia requires proper feeding, sufficient water turnover, effective biofiltration, and regulation of pH and temperature to mitigate NH_3 toxicity (Bartkova *et al.,* 2026). A biofilter in a water supply container can facilitate the transformation of ammonia into nitrate by nitrification, with materials like Pall Ring, coke, and zeolite promoting biofilm development and ammonia elimination (Papola *et al.*). The addition of probiotics can be done because a study has proven that the use of *Bacillus subtilis* probiotics in ornamental fish farming not only degrades NH3-N but also increases the survival rate of koi fish (Tao *et al., 2025)*.

Detergent levels below 0.012 mg/L at all locations indicate that during the sampling, no detergent pollution from household waste, which is potentially toxic to fish, was detected (Halang, 2018). The uniform temperature of 29.6 °C across all locations is likely due to the sampling being conducted at a close time. Because the temperature quality standard is stated as a deviation of 3 °C from the natural temperature and the reference natural temperature was not measured, the temperature conformity cannot be strictly evaluated in this study.

The results of this study have several limitations. The sampling was conducted only once, so daily and seasonal variations were not covered. Parameters closely related to organic matter load and pH buffering, such as alkalinity, nitrite, BOD, and COD, as well as stocking density and container volume data, are not available. Periodic monitoring with more comprehensive parameters is necessary to determine the causes

of low pH and high ammonia. Such monitoring is important because chronically poor water quality can reduce fish resistance to diseases (Boyd, 2017), so improving water quality needs to be combined with the implementation of biosecurity measures in fish farming groups to prevent disease outbreaks (Subasinghe & Shinn, 2023). The documentation of ornamental fish species being raised is similarly crucial, since each species has distinct minimum water quality requirements, hence enhancing the precision and efficacy of water quality management.

CONCLUSION

The water quality for ornamental fish farming in five Pokdakan in Pangkalpinang City generally meets the quality standards for DO, temperature, and detergent parameters, but three locations are right at the minimum DO limit. The pH value is below the quality standards in three Pokdakan (Cg Bukit Intan, Gerunggang Betta, and Pangkalpinang Fancy Guppy) and ammonia exceeds the quality standards in one Pokdakan (Said FM Aquafish). Only Adi Fish Farm meets the required quality standards according to the Class 2 water quality standards in Appendix VI of Government Regulation Number 22 of 2021. The recommended management includes gradually increasing the pH value with lime or baking soda and adding substrates such as gravel and sand accompanied by reducing ammonia through regular water changes, siphoning leftover feed and feces, controlling feed and use of biofiltration. Adding aeration at locations with DO values at the minimum limit, as well as regularly monitoring water quality with more varied parameters for a more measurable water quality analysis and implementing biosecurity to prevent the entry of fish pests and diseases.

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