Jurnal Kesehatan Lingkungan
Journal of Environmental Health
Vol. 15 No. 3
DOI: 10.20473/jkl.v15i3.2023.152-160
ISSN: 1829 - 7285 | E-ISSN: 2040 - 881X
Journal Home Page: https://e-journal.unair.ac.id/JKL
ORIGINAL RESEARCH Open Access

WATER QUALITY STATUS OF WAY BATANGHARI RIVER, METRO CITY, LAMPUNG PROVINCE BASED ON WATER FIT FOR CONSUMPTION PARAMETERS

Vifty Octanarlia Narsan[1], Dimas Ario Setiawan[1]*, Astari Rukmana[1], Rindi Ratna Dewi[1], Suci Anjarwati[1], Resi Suhendri[1]

[1]Tadris Biology Study Program, Faculty of Tarbiyah and Teaching Science, Islamic State Institute (IAIN) of Metro, Lampung 34111, Indonesia

Corresponding Author:
*) dimasario832@gmail.com

Article Info

Submitted	: 26 December 2022
In reviewed	: 18 January 2023
Accepted	: 22 May 2023
Available Online	: 31 July 2023

Keywords : *Chemical parameters, Microorganism parameters, Physical parameters, Water quality*

Published by *Faculty of Public Health Universitas Airlangga*

Abstract

Introduction: *The need of water fit for consumption will continue to be sustainable along with the increasing human population, so we need a source of clean water that suitable for consumption. Therefore, this study aims to determine the water quality status of the Way Batanghari river based on an analysis of the feasibility of potable water.* ***Methods:*** *This research used survey method and water sampling in the Way Batanghari tributary, Metro City, Lampung using the consecutive sampling method.* ***Results and Discussion:*** *The physical parameters which include water color exceeds the 50 TCU and indicates the odor of ammonia. The chemical parameters which include COD were 63.5 mg/L (4th class) upstream, 59.3 mg/L (4th class) downstream. DO values upstream were 4.36 mg/L (1st class), 2.83 mg/L (3rd class) downstream. The phosporus value shows a number of 0.54 mg/L (2nd class). pH parameter which shows a value of 7.1 on the upstream, 6.6 on the downstream. Found species from class of Bacillariophyceae, Cyanophyceae as parameters of pollution.* ***Conclusion:*** *Based on Regulation of the Minister of Health, Republic of Indonesia Number 492 of 2010, this river has color and odor of water shows that indicates not meet the requirements for consumption.*

INTRODUCTION

Water is an essential element that can be a very important element for all living organisms. Without water, there will be no life on earth. This can happen because all living things in general need water for consumption, used as a supporting material for household needs, industry and so on (1). Therefore, water is the most important component in everyday life. Nearly 71% of the earth's surface is water (2). This indicates that the availability of water on earth will always be constant, meaning that it does not experience additions or decreases because water undergoes the hydrological cycle (3). Although the amount of water on earth has always remained the same, the quality of water has changed in line with the growth of the human population and the activities that accompany it. To get suitable water for consumption, it is necessary to have water quality that qualify with the criteria. Good water quality includes physical, chemical and biological quality parameters (4). So that when consumed does not cause side effects for health (3).

The requirements for water fit for consumption or potable have been regulated in the Regulation of Ministry of Health of Republic Indonesia No. 492/MENKES/2010 about Quality Requirements of Drinking Water and Regulation of Ministry of Health of Republic Indonesia No. 32 of 2017 about Environmental Health Quality Standards and Water Health Requirements for Hygiene, Sanitation, Swimming Pools, and Public Baths. The quality standard for clean water are used as a reference for the levels of elements contained in clean water so that it can be determined that the water meets the requirements as water fit for consumptionfor use by the community.

Cite this as :
Narsan VO, Setiawan DA, Rukmana A, Dewi RR, Anjarwati S, Suhendri R. Water Quality Status of Way Batanghari River, Metro City, Lampung Province Based on Water Fit for Consumption Parameters. *Jurnal Kesehatan Lingkungan*. 2023;15(3):152–160. https://doi.org/10.20473/jkl.v15i3.2023.152-160

The United Nations also sets 17 global sustainable development goals to overcome poverty and develop social, economic, and improve environmental quality by 2030. Of the 17 goals of the Sustainable Development Goals (SDG's), there is a sixth goal, namely ensuring the availability and sustainable management of clean water, consumption and sanitation for use in many cases (5). Therefore, efforts to qualify fit for consumption water that has good quality and healthy need to be carried out routine monitoring of clean water which aims to prevent decrease of the water quality and use of water that can interfere with or endanger health.

Geographically, Metro City is located at 105.170-105.190 East Longitude and 5.60-5.80 South Latitude. In this geographical location, Metro City gets a rainfall index whose cycle fluctuates every year. In January, the amount of rainfall can reach an average of 240.8 mm and decrease until July which reaches the amount of rainfall of 39.1 mm and increases again until December which reaches the number of rainfall of 198.0 mm (6). Climate change that occurs, such as temperature and rainfall, will have an impact on the volume of runoff and change the transportation as well as the dilution and ecokinetics of contaminants in the waters (7).

The Way Batanghari tributary is a river that flows through most of Metro City. The water of the Way Batanghari river is a source of water which has an important role for the ecosystem in Metro City, especially for living things in the river and for people who need river water for consumption, agriculture, domestic needs, and so on. Even though the water source from the river is possible for consumption, it is still necessary to know its eligibility based on applicable regulations.The quality of river water is also affected by rainfall, so it is necessary to carry out research that examines the suitability level of river water to be able to meet the needs of human's life.

Based on the problems that have been described, it is necessary to conduct research on the analysis of water quality parameters that are suitable for consumption. In the Way Batanghari tributary, Metro City. This is important to do in order to know the level of feasibility and quality status of water in the Way Batanghari tributary for consumption so that after reviewing its quality, the tributary water can function according to its designation and can be used as a reference in water treatment if the tributary water is suitable to be used as a source of raw water. as drinking water by the people of Metro City.

METHODS

This research used survey method, and mixed research types or qualitative and quantitative research which not only collects and analyzes data, but also involves the functions of quantitative and qualitative research which are expected to provide a more complete understanding of the research problem. raised. The sample used in this study was water in the Way Batanghari tributary through a sampling method in the form of consecutive sampling.

The research was conducted for 3 days. On 2022 November 18, 23 and 25 which are samples of days where high rainfall occurred on the previous day in the tributary of the Way Batanghari, Sumber Sari Village (upstream) and Iringmulyo Village (downstream), Metro City, Lampung Province to find out the average comparison of water quality values in the upstream and downstream of the river.

Sampling was carried out by consecutive sampling at 5 stations which included 2 stations on the upstream side, and 3 stations on the downstream side of the Way Batanghari tributary. Sampling at the location includes physical parameters such as color and odor. While chemical parameters include pH, Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), and Phosphorus (P) as well as microbiological parameters. The water samples taken were then brought to the Technical Implementing Service Unit, Integrated Laboratory and Technology Innovation Center of the University of Lampung, to undergo testing using fit for consumption water parameters suitable for consumption based on the reference which is Regulation of the Minister of Health, Republic of Indonesia Number 492 of 2010 and clean water parameters based on Regulation of the Minister of Health, Republic of Indonesia Number 32 of 2017 and Government Regulation Number 22 of 2021 which also includes several parameters of water quality in waters, namely physical parameters, chemical parameters, and microbiological parameters.

RESULTS

Based on the analysis of water quality through water samples obtained from the Way Batanghari tributary based on physical, chemical and microbiological parameters, the following data are obtained.

Chemical Parameters

Chemical Oxygen Demand (COD)

The following is the data obtained from Chemical Oxygen Demand (COD).

Table 1. Average Results of Chemical Oxygen Demand (COD) Measurements in the Way Batanghari River

ST	COD	Percentage (%)	Quality Standards	Method
Upstream	63.5 mg/L	12.70	4th Class	In House Method
Downstream	59.3 mg/L	11.86	4th Class	In House Method

Based on the data obtained through In House method, the average value of Chemical Oxygen Demand (COD) at the upstream station is 63.5 mg/L and the downstream station is 59.3 mg/L. In accordance with Government Regulation of water quality standards No. 22 of 2021 the values of both fall into the criteria for 4th class.

Dissolved Oxygen (DO)

The following is the data obtained from Dissolved Oxygen (DO).

Table 2. Average Results of Dissolved Oxygen (DO) Measurements in the Way Batanghari River

ST	DO	Percentage (%)	Quality Standards	Method
Upstream	4.36 mg/L	0.87	1st Class	SNI 06-2425-1991
Downstream	2.83 mg/L	0.57	3rd Class	SNI 06-2425-1991

Based on the data obtained through the standard SNI 06-2425-1991 method, the average value of Dissolved Oxygen (DO) at the upstream station is 4.36 mg/L and the downstream station is 2.83 mg/L. Equivalent to the quality standard reference Government Regulation No. 22 of 2021 at the upstream station it is included in class 1 while the downstream station is included in 3rd class.

Phosphorus (P)

The following is the data obtained from Phosphorus (P).

Table 3. Average Results for Phosphorus (P) Measurements in the Way Batanghari River

ST	Phosphorus (P)	Percentage (%)	Quality Standards	Method
Upstream	0.543 mg/L	0.11	2nd Class	EPA 200.7 revision 5, 2001
Downstream	0.54 mg/L	0.11	2nd Class	EPA 200.7 revision 5, 2001

Based on the data obtained through the standard EPA 200.7 5th revision, 2001, the average value of phosphorus at the upstream station was 0.543 mg/L and the downstream station was 0.54 mg/L. In accordance with the Government Regulation quality standard reference. No. 22 of 2021, the two stations are included in the 2nd class quality standard.

Degree of Acidity (pH)

The following is the data obtained from the degree of acidity (pH).

Table 4. Average Results of pH Measurements in The Way Batanghari River

Parameter	Upstream	Downstream	Quality Standards
pH	7.1	6.6	6.5 - 8.5

Based on the data obtained through executive sampling, the average pH value at the upstream station was 7.1 and the downstream station was 6.6. In accordance with the reference quality standards of the Minister of Health Regulation No. 32 of 2017, the two stations are still within normal limits because they are in the range of 6.5-8.5.

Microorganism Indicator
Phytoplankton and Zooplankton

The following is the data obtained from the identification of Phytoplankton and Zooplankton.

Table 5. Results of Phytoplankton and Zooplankton Measurements in the Way Batanghari River

Types of Microorganisms	Class	Information	Part
Trichostrongylus sp.	*Chromadorea*	Zooplankton	Upstream
Rhabdolaimus terrestris	*Adenophorea*	Zooplankton	
Nasula	*ciliates*	Zooplankton	
Gloeocapsa	*Cyanophyceae*	Phytoplankton	
Spirogyra	*Chlorophyceae*	Phytoplankton	
Closterium porrectum	*Conjugatophyceae*	Phytoplankton	
Flagilaria sp.	*Bacillariophyceae*	Phytoplankton	
Nitzschia sigma	*Bacillariophyceae*	Phytoplankton	
Euglena	*Flagellates*	Phytoplankton	
Srtongyle	*Chromadorea*	Zooplankton	
Brachionus sp.	*Monogonota*	Zooplankton	
Moana micura	*Branchiopods*	Zooplankton	
Bacillaria paradoxa	*Bacillariophyceae*	Phytoplankton	
Nitzschia lorenziana	*Bacillariophyceae*	Phytoplankton	
Asplanchna sp.	*Monogononta*	Zooplankton	
Neptune Rotaria	*Eurotatoria*	Zooplankton	
Ankistrodesmus	*Chlorophyceae*	Phytoplankton	
Neidium afiine var. Aplennida	*Bacillariophyceae*	Phytoplankton	
Gronbladia neglecta sp.	*Chlorophyceae*	Phytoplankton	
Lemanea sp.	*Florydeophyceae*	Phytoplankton	
Amount		**Phytoplankton : 12 Species**	
		Zooplankton : 8 Species	

Types of Microorganisms	Class	Information	Part
Oscillatoria	Cyanophyceae	Phytoplankton	Downstream
Ankistrodesmus	*Chlorophyceae*	Phytoplankton	
Closterium	*Conjugatophyceae*	Phytoplankton	
Noctiluc	*Dinophyceae*	Phytoplankton	
Anisonema	*Peranemea*	Phytoplankton	
Chrysusthaerales	*Chrysophyceae*	Phytoplankton	
Trichodermus	*Cyanophyceae*	Phytoplankton	
Surirella	*Bacillariophyceae*	Phytoplankton	
Eucheuma	*Rhodophyceae*	Phytoplankton	
Coscinodescus	*Coscinodiscophyceae*	Phytoplankton	
Multicilia	*Discosea*	Zooplankton	
Entosiphon	*Euglenoidea*	Phytoplankton	
Actinocomma	*Sarcodina*	Zooplankton	
Amount		**Phytoplankton : 11 Species**	
		Zooplankton : 2 Species	
Total Number		**Phytoplankton : 23 Species**	
		Zooplankton : 10 Species	

Based on observations made on water samples from 5 stations in the Way Batanghari tributary through executive sampling, phytoplankton and zooplankton were identified. From these observations and identification at the upstream station, 12 species of identified phytoplankton were identified, while 8 species were identified as zooplankton. Meanwhile, at the downstream stations, 11 species of phytoplankton were identified and 2 species of zooplankton were identified. So that the total acquisition of phytoplankton is 23 species while zooplankton is 10 species.

DISCUSSION

The quality of water suitable for consumption can be seen through physical parameters such as color and odor. Based on the water color sampling conducted, it can be seen that the water in the Way Batanghari tributary at the upstream and downstream stations is light brown. Light brown waters indicate or are polluted by organic waste (8). Therefore it can be concluded that these waters contain organic waste. Organic waste itself includes animal carcasses, animal waste, and aquatic plants which cause microorganisms/bacteria to become uncontrollable, making the water unfit for consumption. The accumulation of organic waste in the water can cause the growth of microorganisms or the proliferation of aquatic plants which inhibit the entry of sunlight into the water (8).

The day before the water color sampling, there was heavy rain which caused the color of the Way Batanghari tributary to become cloudy. In line with previous research, the color turbidity indicator is influenced by influents that enter river water, both in the form of waste and rainwater (9). Light brown color can also be an indicator of the presence of suspended solids (sand, silt, and clay) or suspended particles such as living components (biotic) such as phytoplankton, zooplankton, bacteria, fungi or dead components (abiotic) such as detritus and inorganic particles and substances (10).

If the water is cloudy, it can be determined that the water contains hazardous substances so that it does not meet the category of clean water and fit for consumption water (11). Of course, one of the characteristics of water fit for consumption that needs to be understood is its stable clarity (11). Therefore, it can be concluded that the color of the upstream and downstream tributaries of Batanghari is not suitable for consumption, because they do not meet the color quality standard, which is clear. As a quality standard for drinking water and water hygiene and sanitation, the clarity scale limit is up to 50 True Color Unit (TCU) (11) for clean water and 15 TCU for water fit for consumption (12), clear and fit for consumption water indicates a total TCU below 50, and if the water is colored, it can indicate that the water is over 50 TCU (13). If the water containing TCU exceeds the quality standard for drinking water, it will causevarious digestive disorders such as nausea, vomiting, diarrhea or other health problems such as fever, dizziness, sore throat, stomach cramps, and hepatitis infection (11).

In addition, based on odor parameters samples, the waters at the upstream and downstream stations of the Way Batanghari tributary indicated that the odor of the waters upstream of the Batanghari tributary smelled neutral and the downstream smelled of ammonia. The smell of ammonia in the downstream creek indicates that industrial waste has entered the water. Ammonia levels in river water above the threshold can damage aquatic ecosystems and other organisms. If the dissolved ammonia in a water is too high, it will cause poisoning for all aquatic organisms (14).

Substance of ammonia can be toxic agent for if the amount of ammonia that enters the body exceeds the normal levels of ammonia that can be detoxified by the body. For humans, there is a significant risk of inhaling ammonia vapor which can cause several effects, including skin irritation, eyes irritation and also respiratory tract. In very high concentrations, inhalation of ammonia vapors is fatal. If ammonia dissolved in the waters it will increase the concentration of ammonia which causes poisoning for almost all aquatic organisms including fishes, plankton, invertebrates organisms (14). Ammonia in certain levels can improve conditions and encourage plant growth (15). Ammonia can also act as a nutrient that encourages the growth of phytoplankton and fish (16). Excessive levels of Ammonia can cause

eutrophication and disrupt aquatic life (14). Ammonia can harm aquatic life starting from a concentration of 1 Mg NH3/L which causes some small fish to suffocate (14).

Based on the Regulation of the Minister of Health, Republic of Indonesia Number 492 of 2010, the odor parameter for clean water fit for consumption is odorless water (12). If we look at the odor parameters that have been set, the water of the upstream Way Batanghari tributary can be classified as meeting the quality standards for clean water and drinking water because it has a neutral odor according to the Regulation of the Minister of Health, Republic of Indonesia Number 492 of 2010 (12). Whereas in the downstream of the Way Batanghari tributary it can be classified as not meeting the quality standards for clean water and water fit for consumption because it smells of ammonia and does not meet the provisions of the Regulation of the Minister of Health, Republic of Indonesia Number 492 of 2010 (12).

The quality of clean and suitable water for consumption is also assessed based on chemical parameters which include Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), and Phosphorus (P) and also the degree of acidity (pH). Factors affecting the COD value in the waters are the use of fertilizers which stimulate the growth of phytoplankton and overfeeding in the waters which is considered a factor for the high COD value. COD is an estimate of the total amount of organic waste that easily decomposes in water (17). COD is a measure of the oxygen consumed by microorganisms during the oxidation of organic matter which can be oxidized with the help of strong oxidizing agents (17). Organic matter found in waters can be determined based on the size of COD. This makes COD an indicator of organic pollution in surface waters (18).

Based on the results of research on COD quality at upstream stations, namely 63.5 mg/L while at the downstream station it is 59.3 mg/L. Based on with Government Regulation No. 22 of 2021 which describes the Implementation of the Protection and Management of the Living Environment states that the COD parameter ranges from 41-80, it can be stated that the flow Way Batanghari tributary for COD value is included in 4th class of water quality. 4th Class indicates that the river's water quality is water that can be used to irrigate plants and can be suitable for plantations or other uses that require the same quality of water as the water quality.

High value of COD indicates that the water contains microorganisms or contaminants that are pathogenic or non-pathogenic (19). Water that is polluted, for example by domestic waste or industrial waste generally has a high COD value (20), whereas uncontaminated water has a low COD because of this, it requires greater degradation of organic matter (21). The COD test is used to measure the oxygen equivalent of organic matter in wastewater which can be chemically oxidized by the use of dichromate in an acid solution (22). An increase in COD will result in reduced dissolved oxygen in the water (21). In waters with a COD value that is included in 4th class of water quality, if consumed it will cause various diseases for humans because high COD concentrations in waters indicate that there are high amounts of organic pollutants, including organic pollutants such as microorganisms that are pathogenic or non-pathogenic (23).

Based on Government Regulation concerning Implementation of Environmental Protection and Management Number 22 of 2021 (24) stipulates that the range of 1st class water quality based on Dissolved Oxygen (DO) parameters is 4mg/L to 6mg/L. It can be said that the DO parameter of the tributaries in the upstream Way Batanghari is 1st class, and the DO parameter for 3rd class is the DO value in the range of 1 mg/L to 3 mg/L. DO value at the downstream station in the 3rd class.

Based on Government Regulation. Number 22 of 2021, level 1 standard for Dissolved Oxygen (DO) parameters meets drinking water or fit for consumption standards. While the class 3 quality standard is water that can be used for freshwater fish farming, animal husbandry, crop irrigation, or other uses that require water of an appropriate quality. 3rd class DO value indicates that the DO value in these waters is low. The low levels of DO in this category limit the use of water in the waters for livestock and agriculture. Low DO values in water can be caused by decomposition of organic matter and oxidation of organic matter. Dissolved oxygen levels will also decrease as organic waste increases in these waters (25).

Dissolved Oxygen or better known as DO, is oxygen contained in water and is measured in Part Per Million (ppm). Dissolved oxygen is used as an indicator of the use of raw water (26). Oxygen is the main chemical element that is essential for the life of various organisms. Oxygen is used by aquatic organisms as a process of respiration and decomposition of organic matter converted into inorganic substances by microorganisms (27). Dissolved oxygen in water comes from air diffusion and photosynthetic organisms that contain chlorophyll live in water bodies and require oxidation of nutrients by organisms entering their bodies (28). The greater the dissolved oxygen, it will show that the impurities are

relatively small which indicates the high value of DO (29). The greater the solubility value of the pollutant in water, the lower the DO value indication (21).

After reviewing based on the environment around the Way Batanghari tributary, there are agricultural land and residential areas. In line with previous research that examines the Influence of Community Behavior on Water Quality in the Sekanak River in Palembang City in 2019, the content of phosphorus compounds in river water comes from the remaining use of fertilizers (N, P, & K) and pesticides in agricultural activities (30). Apart from that, phosphorus compounds are also produced from public bathing, washing, and toilet facilities (9). Household waste water such as detergents (31) can be a source of pollutants which results in high phosphorus value (30).

Batanghari tributary is classified as 2nd class of water quality. In this 2nd class indicates better water quality, but does not meet the water quality standards to be fit for consumption. Water at level 2 can only be used for water rides, fish farming, and for irrigating plants or for other purposes where the conditions for this water quality can be met. In other words, the quality of this water does not meet the quality standards suitable for consumption.

Based on the Regulation of the Minister of Health, Republic of Indonesia No. 32 of 2017, the standard degree of acidity (pH) in river water is in the range of 6.5 – 8.5 (13). Based on this reference, the average pH value in the upstream and downstream of the Way Batanghari tributary shows that the pH level is still within normal levels. Based on Government Regulation No. 22 of 2021, the acquisition of an average pH value of 6.6 – 7.1 is included in the class 1 category which states that This water can be used as raw water to become drinking water or other uses that require the same water quality as that used. Thus, if just analyzed based on value the pH of the water in the Way Batanghari tributary, it is classified as a water quality standard that is qualify to be suitable for water fit for consumption or portable water.

Value of pH is important for determining quality of the water, because it is related to the acidity of the water (32). The lower the pH value indicates the higher the acidity of the water (33), and vice versa. pH conditions can impact on the level of toxicity of a chemical compound (29), and affect the aquatic biochemical processes and metabolic processes of aquatic organisms (34). Changes in temperature and pressure will affect the CO_2 content in water which in turn will affect the pH value (35). Changes in water pH are affected by changes in temperature and pressure which can cause changes in the CO_2 content in the water (36).

To monitor the feasibility status of clean water and suitable for consumption can also be reviewed based on the parameters of microorganisms**.** Based on the identification that has been carried out, it was found that the number of phytoplankton species was dominated by the *Bacillariophyceae* class, namely 6 species which included *Flagilaria* sp., *Nitzschia sigma*, *Bacillaria paradoxa*, *Nitzschia lorenziana*, *Neidium afiine var*, *Aplennida*, *Surirella*. Species in the *Bacillariophyceae* class can grow quickly even in low nutrient and light condition (37). Species in this class can reproduce and regenerate in large ratios and are able to adapt well to low-nutrient conditions (38). The role of phytoplankton in the *Bacillariophyceae* class is as an indicator of pollution because it has a cell wall structure composed of silica so that it can survive and can take advantage of unfavorable water condition (39). Therefore, the dominance of species from the *Bacillariophyceae* class indicates that these waters are polluted (40), species of *Bacillariophyceae* are pollution bioparameters (41).

Species from the *Cyanophyceae* class such as *Oscillatoria* sp. are known to be a type of phytoplankton that are toxic to other organisms (42), because they can secrete neurotoxins (anatoxin-a and homoanatoxin-a) (43), which have the potential to be toxins for aquatic ecosystems (44). Then other species from the *Cyanophyceae* class found such as *Gloeocapsa* are less useful because they can cause blooms (population explosion) (45). This blooming causes the waters to turn green, blue and even black (44), making it dangerous for invertebrates such as crustaceans to higher species such as fish and other organisms because there are indications of neurotoxin secretion by species in the *Cyanophyceae* class (45).

When viewed from the quality standards for drinking water or fit for consumption, good water for consumption is water that is odorless, colorless and does not contain harmful substances (10). So that the water of the Way Batanghari tributary which is dominated by the *Bacillariophyceae* class which indicates pollution and the discovery of species from the *Cyanophyceae* class that can secrete toxic substances can be concluded that it does not meet the requirements for consumption as drinking water or in other words not suitable for consumption.

CONCLUSION

Based on research that has been carried out regarding the water quality status based on parameters suitable for consumption in the Batanghari Way tributary, Metro City can be concluded that the water quality parameters from the physical, chemical and

microorganism aspects in the Way Batanghari tributary water indicate water that does not meet the requirements fit for consumption. The water of this tributary shows pollution characteristics which can be seen in the turbid brown color, the smell of Ammonia, the COD and Phosphorus values which exceed the standards for potable water so that squeezing microorganisms are found as bioparameters of pollution. So it can be said that the water quality of the Way Batanghari tributary does not meet the water quality standard requirements for proper potable water or consumption water.

This research needs to be developed related to monitoring the analysis of water quality parameters suitable for consumption with more varied time, developing parameters of water quality suitable for consumption that can be tested on river water so that the data obtained is more credible to determine that can be tested on river water so that the data obtained are more credible to determine the quality of water suitable for consumption.

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