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COCONUT SHELLS, WATER HYACINTH, AND RICE IN IMPROVING THE QUALITY OF DUG WELL WATER IN FLOOD AREAS

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Abstract

Introduction: *Ensuring access to clean and safe drinking water is crucial, especially in flood-prone regions where the water quality in dug wells can deteriorate due to various physicochemical factors. This research was aimed to measure the effectiveness of natural materials in improving water quality based on physicochemical parameters and to compare water quality before and after treatment in Astambul Subdistrict of Banjar Regency, South Kalimantan Province.* ***Methods:*** *The study involved a survey of 192 private boreholes and dug wells across five villages in the Astambul Subdistrict, with 30 samples selected for detailed analysis. Key physicochemical parameters analyzed included total dissolved solids (TDS), dissolved oxygen (DO), turbidity, and total suspended solids (TSS). TDS, with a standard limit of 50 mg/L, served as a primary water quality indicator. DO, essential for gauging water oxygenation, and was measured as it results from photosynthesis and atmospheric absorption. Turbidity was assessed using a turbidimeter to determine water clarity, and a UV-vis Spectrophotometer 2008 was utilized to measure levels of iron (Fe) and mangasene (Mn).* ***Results and Discussion:*** *The findings demonstrated that coconut shells, husks, and water hyacinths improved water quality across physical and chemical parameters. Statistical analysis using t-tests showed improvements in these parameters after treatment. For example, DO levels increased in multiple villages, with the highest percentage in Kaliukan Village (59.2%) and decreases in turbidity and TSS.* ***Conclusion:*** *The study concluded that coconut shells, husks, and water hyacinths have potential to enhance physicochemical quality of water.*

INTRODUCTION

Accessing clean and safe drinking water is essential to people's health and well-being. However, in flood areas, water in dug well quality often deteriorates based on physicochemical parameters (1-2). The Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017 mandates that clean water quality adheres to high standards, encompassing physical, chemical, and microbiological criteria (3). The characteristics of water, such as its color, temperature,

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acidity, hardness, pH level, sulfate, chloride content, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), and alkalinity, are considered physicochemical (4-5).

The Astambul Subdistrict, comprising five villages and a total population of 8,560 residents, faces a pressing issue of inadequate access to clean water. Within this population, 2,796 individuals belong to marginalized groups such as the poor, vulnerable, and disabled. Situated in the Banjar district, this area grapples with a consistent water crisis throughout the year, exacerbated by frequent floods during the rainy season. These floods not only disrupt daily life but also degrade water quality, rendering it turbid and falling short of acceptable physical, chemical, and bacteriological standards. This is confirmed based on a previous study in September 2021 in six village areas, namely Kelampaian Ulu and Kelampaian Tengah with a depth of > 75 meters and a specific gravity of 89.58 Ωm and the groundwater quality looks cloudy; Lok Gabang with a depth of > 75 meters and a specific gravity of 133.53 Ωm and the groundwater quality looks cloudy; Kaliukan with a depth of > 70 meters and a specific resistance of 122 Ωm and groundwater quality looks cloudy, Sei Alat with a depth of > 70 meters and a specific resistance of 122.03 Ωm and groundwater quality looks cloudy with cloudy water conditions for surface water and well water with a maximum depth of 76 meters for groundwater and 5 - 10 meters main (6-7).

Long-term consequences of low-quality water can include bone density reduction, dental decay, blood deficiency, and renal impairment. These effects occur as a result of water contamination with heavy metals, which are typically harmful and accumulate in the kidneys (8). This poses a significant challenge to the communities relying on those water sources. To address this issue, new and sustainable methods to enhance water quality are being explored. A promising approach involves using natural materials such as coconut shells (9), water hyacinths (10), and rice husks (11), which have been shown to improve the physical and chemical standards of water.

Coconut shells are abundant agricultural byproducts known for their high porosity and contaminant adsorbtion capabilities (12-13). They contain natural activated carbon, which can effectively remove impurities, including organic compounds, heavy metals (13), and pathogens (14), from water. Research has shown that coconut shells (CNS) can serve as a cost-effective adsorbent for eliminating heavy metals from aqueous solutions with low metal concentrations (15).

Water hyacinth, an aquatic plant that proliferates in freshwater ecosystems (16), is often considered invasive but has significant potential applications in water treatment due to its high nutrient uptake (17) and pollutant removal capabilities (18). It can absorb heavy metals and other contaminants, thereby improving water clarity and quality (19-20).

Rice husks, an agricultural waste generated during rice milling processes, possess natural adsorption properties and are rich in silica, making them suitable for water treatment applications (21). Rice husks can remove various pollutants, including heavy metals and organic compounds, through physical and chemical processes such as adsorption and catalysis (22).

Plants and local waste materials like coconut shells, water hyacinth, and rice husks can be processed into activated carbon such as charcoal and ash. This activated carbon can absorb gases and specific chemical compounds due to its selective adsorption properties determined by pore size and surface area. Activated carbon's absorption capacity is significant, ranging from 25% to 1000% of its weight, making it effective in mitigating organic contaminants and synthetic organic particles, as well as reducing inorganic pollutants like radon, mercury, and other hazardous metals (23-24).

Integrating coconut shells, water hyacinths, and rice husks in water treatment systems provides a comprehensive solution for improving the quality of dug well water in flood-prone areas. By leveraging the complementary properties of these natural materials, multiple water quality parameters can be addressed simultaneously, enhancing the efficiency and sustainability of water treatment processes while minimizing environmental impact. Moreover, using locally available resources promotes community involvement in addressing water-related challenges.

Using coconut shells, water hyacinths, and rice husks offers a promising strategy for enhancing the physical and chemical standards of dug well water in flood-prone areas. These natural materials provide cost-effective, environmentally friendly, and sustainable solutions to water quality issues. By harnessing the potential of these resources, communities can improve access to clean and safe drinking water, thereby safeguarding public health and promoting resilience in the face of natural disasters. Based on this explanation, the study aimed at improving access to clean water by mapping soil quality and identifying clean water sources in Banjar Regency Astambul District.

METHODS

The number of wells in five villages in Astambul Subdistrict is 192 private boreholes and dug wells. The number of samples to be taken is 30 samples (25).

Samples were taken by proportional random sampling method:

$$\frac{\text{Number of Wells}}{\text{Total Population}} \times 30$$

Table 1. Number of Samples for Each Village

Village	Sample
Sungai Alat	7 points
Keliukan	6 points
Lok Gabang	6 points
Kelampaian Ulu	6 points
Kelampaian Tengah	5 points
Total	30 points

Turbidity parameters were measured using a turbidimeter. The working method refers to SNI 06-6989.25-2005. Total dissolved solids are particles larger than 2 microns found in water with a maximum standard of 50 mg/L (26). A water quality parameter measures the amount of solids dissolved in water. According to the Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023, the standard for dissolved oxygen (DO) in water is less than 300 mg/L. DO refers to the amount of oxygen dissolved in water, which originates from photosynthesis and absorption from the atmosphere. The Indonesian Government Regulation Number 82 of 2001 specifies that a good DO level for sanitary hygiene water should be at least 4 mg/L.

Checking pH is done with a pH meter and litmus paper. The examination method refers to SNI 06-6989.11-2004. Fe and Mn examination using UV vest Spectrophotometer 2008 (Biochemistry Lab, Faculty of Medicine ULM). The examination was done once. The tools used are the UV vest 2008 spectrophotometer, cuvette, Erlenmeyer, measuring cup, drop pipette, and stopwatch. The materials used were distilled water and Fe reagent. The examination method refers to SNI 6989.4: 2009. Mn examination was carried out once. The tools used are a cuvette, UV vest 2008 spectrophotometer, and turbidimeter. The materials used include ascorbic acid powder, alkaline cyanide, PAN indicator solution 0.1%, water before pre-water treatment, water after pre-water treatment, and aquadest. The method of examination refers to SNI 6989.5: 2009.

RESULTS

Examination Results of Physical Quality Treatment of Clean Water in Five Villages

DO (*Dissolved Oxygen*)

The results of water testing in the Astambul Subdistrict after being treated using natural materials (husks, coconut shells, and water hyacinths) showed that the average increase in DO was the highest in the treatment with water hyacinths, namely the percentage increase in Kaliukan Village 2.43 (59.2%), Kelampaian Ulu 2.17 (45.2%), Sungai Alat 1.83 (39.7%), Kelampaian Tengah 1.33 (23.7%), and Lok Gabang 1 (17.8%). The post-test values using the control were better than the treatment. However, the treatments were able to increase DO (shell, husk, and water hyacinth with the best dose of 0.6 (51% husk) 1.8 (20% husk), and 2.4 (88%).

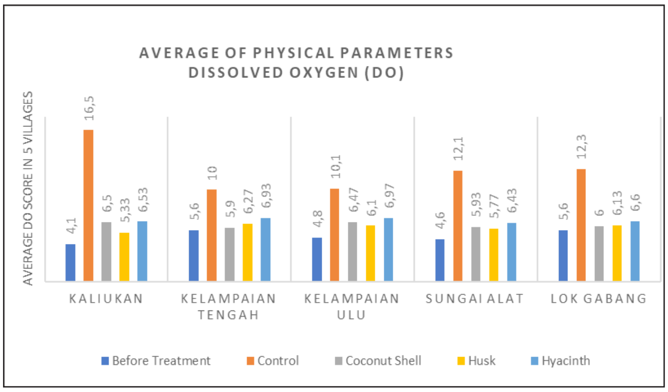

Figure 1. Average DO Score in Five Villages

Table 2. Results of Physical Geoelectric Measurements

Treatment	Village				
	Kaliukan	Kelampaian Tengah	Kelampaian Ulu	Sungai Alat	Lok Gabang
Total Dissolved Solid (TDS)					
Before Treatment	102.000	95.000	95.000	97.000	94.000
Control	132.000	256.000	258.000	232.000	194.000
Coconut Shell	104.000	98.300	97.300	87.300	96.700
Husk	106.000	96.300	98.000	85.300	95.700
Hyacinth	126.300	116.300	116.000	105.700	115.700
Dissolved Oxygen (DO)					
Before Treatment	4.100	5.600	4.800	4.600	5.600
Control	16.500	10.000	10.100	12.100	12.300
Coconut Shell	6.500	5.900	6.470	5.930	6.000
Husk	5.330	6.270	6.100	5.770	6.130
Hyacinth	6.530	6.930	6.970	6.430	6.600
Turbidity					
Before Treatment	19.230	55.000	83.000	82.000	86.000
Control	5.780	0.790	0.740	1.820	3.730
Coconut Shell	7.470	19.110	13.640	7.220	22.360
Husk	8.990	23.190	25.160	6.210	36.820
Hyacinth	9.750	21.520	24.630	18.030	31.870
Total Suspended Solid (TSS)					
Before Treatment	6.130	3.980	3.530	6.770	6.100
Control	0.065	0.120	0.240	0.240	0.220
Coconut Shell	0.180	0.190	0.340	0.210	0.530
Husk	0.090	0.030	0.010	0.090	0.670
Hyacinth	1.310	2.330	1.770	1.880	2.270

Table 3. Results of Geoelectric Chemistry Measurements

Treatment	Village				
	Kaliukan	Kelampaian Tengah	Kelampaian Ulu	Sungai Alat	Lok Gabang
Ph					
Before Treatment	6.700	6.400	6.800	6.600	7.000
Control	7.250	5.390	6.020	6.280	7.000

Treatment	Village				
	Kaliukan	Kelampaian Tengah	Kelampaian Ulu	Sungai Alat	Lok Gabang
Coconut Shell	6.670	6.400	6.870	6.570	6.930
Husk	7.070	6.770	6.770	6.800	7.130
Hyacinth	6.600	6.500	6.600	6.700	6.870
Iron (Fe)					
Before Treatment	0.409	0.544	0.376	0.534	0.438
Control	0.092	0.092	0.097	0.097	0.101
Coconut Shell	0.279	0.231	0.472	0.247	0.119
Husk	0.161	0.114	0.190	0.215	0.117
Hyacinth	0.400	0.365	0.117	0.403	
Mangan (Mn)					
Before Treatment	8.000	11.200	7.600	9.200	14.000
Control	6.800	7.400	7.600	6.400	7.400
Coconut Shell	6.800	6.470	6.730	6.600	6.330
Husk	6.470	6.870	6.470	6.200	6.330
Hyacinth	6.470	7.130	6.730	7.470	6.670

TDS (*Total Dissolved Solid*)

The results of water testing in Astambul District after being treated using natural materials (husks, coconut shells, and water hyacinths) showed that the average TDS value increased. However, the natural material that experienced the least increase was water hyacinth, namely in Kaliukan Village 5.7 (0.057%) and Lok Gabang 78 (0.78%). The results of the TDS examination with natural materials show that all materials can increase TDS, namely coconut shells, husks, and water hyacinths. This is because all natural materials contain active ingredients that can improve the quality of clean water. The TDS value after the test using the dick increased compared to the treatment. The results after treatment also increased the TDS value, but it was smaller than the control and still below the quality standard threshold. The lowest increase in TDS was in the treatment with a dose of 1.8 gr. Shell did not increase, husk only increased by 5 gr/L (0.3%), while water hyacinth increased by 30 gr/L (29%). This shows that the results using the treatment are better than using the control.

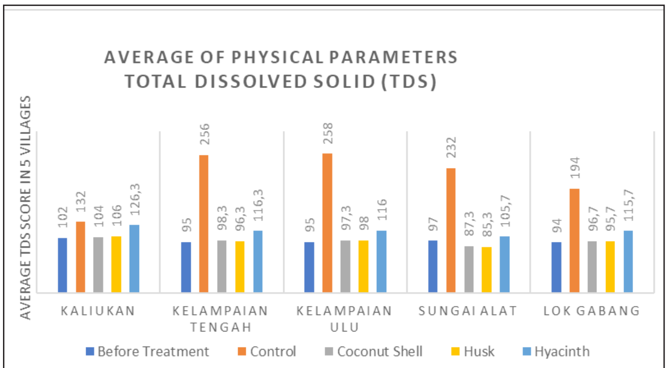

Figure 2. Average TDS Score in Five Villages

Turbidity

The results of water testing in the Astambul Subdistrict area after being treated using natural materials (husks, coconut shells, and water hyacinth) showed that the average turbidity value decreased. The highest decrease in turbidity value was dominated by the coconut shell treatment, namely Sungai Alat Village 74.78 (91%), Kelampaian Ulu 69.36 (84%), Lok Gabang 63.64 (74%), Kelampaian Tengah 35.89 (65%), and Kaliukan 11.76 (61%).

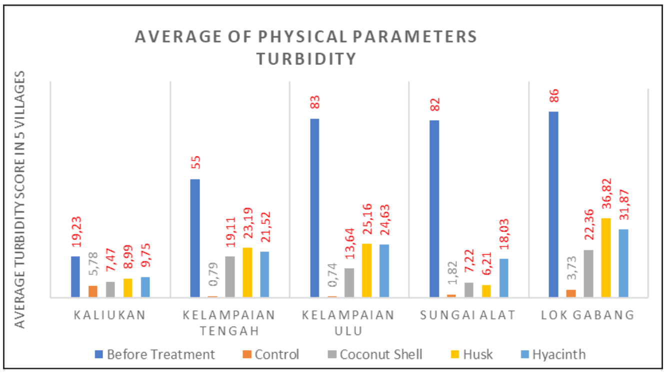

Figure 3. Average Turbidity Score in Five Villages

The results of the examination of turbidity with natural materials show that all materials can increase, namely 75% coconut shells (from an average of 7.8 down to 19), 55% husks (from an average of 7.8 down to 23), 55% (from an average of 7.8 down to 23). The value after the test using the dick is better than the treatment. However, the treatment was able to increase DO (shell, husk, and water hyacinth with the best dose of 0.6 (51% husk) 1.8 (20% husk), and 2.4 (88%).

TSS (Total Suspended Solid)

The results of water testing in the Astambul Subdistrict area after being treated using natural materials (husks, coconut shells, and water hyacinth) showed that the average TSS value decreased. The highest TSS value decrease was dominated by the husk treatment, namely Kelampaian Ulu Village 3.52 (99.7%), Kelampaian Tengah 3.95 (99.2%), Sungai Alat 6.68 (98.6%), Kaliukan 6.04 (98.5%). However, in Lok Gabang Village, the highest TSS value reduction was dominated by the coconut shell treatment. The post-test value using the control was better than the treatment. However, the treatments were able to reduce TSS (shell, husk, and water hyacinth with the best dose of 0.6 (98% husk) 1.8 (98% husk) (98% shell), and 2.4 (99%).

The results of water testing have decreased the TSS value after treatment with rice husk-activated carbon so that it has met the quality standards of clean water. This demonstrates that the reduction in suspended solids results in clearer water, as suspended solids are directly linked to water turbidity. Consequently, activated carbon is more affective in lowering the TSS (Total Suspended Solids) value (27-28).

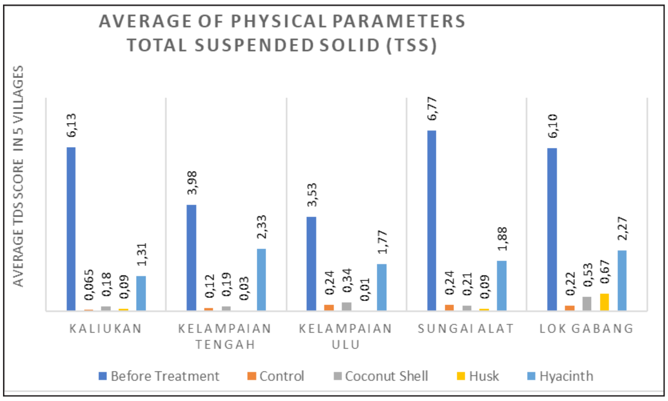

Figure 4. Average TSS Score in FiveVillages

Examination Results of Chemical Quality Treatment of Clean Water in 5 Villages

pH

pH testing on water samples in Astambul Subdistrict obtained the lowest pH level value in Kelampaian Tengah Village, which is 5.4 mg/l with processing using coconut shells. The highest pH value is found in Kelampaian Ulu and Lok Gabang Villages, which is 6.87 mg/l with processing using water hyacinth. Based on the average results, Kelampaian Tengah Village with treatment using water hyacinth produces a pH value of 6.4 mg / L and does not comply with the quality standard of 6.5-8.5 mg / L.

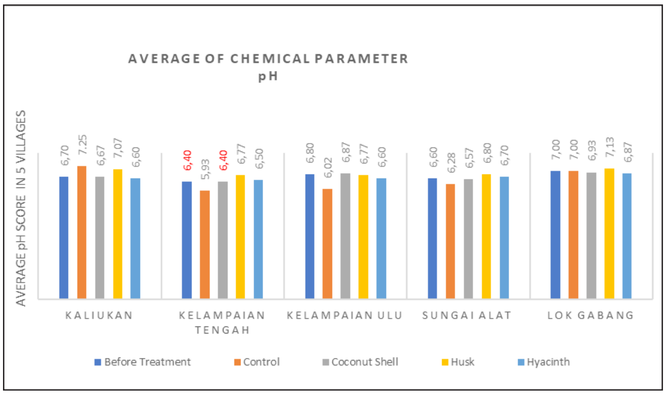

Figure 5. Average pH Score in Five Villages

The other four villages in Astambul Subdistrict (Kaliukan, Kelampaian Ulu, Sungai Alat, Lok Gabang) have pH levels that are classified as normal, namely in the range of 6.5-8.5 mg/l, and the water used for sanitary hygiene needs with a standard of 6.5-8.5 mg/liter. Based on the figure above, it shows that the water after treatment using activated carbon from natural materials (husks, coconut shells, and water hyacinth) has increased pH and is classified in the normal category according to the standard. After treatment, it can be seen that treatment with natural materials (husks, coconut shells, and water hyacinth) functions in raising the pH value. The value after the test using the dick is better than the treatment. However, the treatment was able to reduce the pH (coconut shell, husk, and water hyacinth with the best dose of 0.6 (1% husk) 1.8 (3% husk), and 2.4 (12% for all materials (coconut shell, husk, and water hyacinth).

Iron (Fe)

Testing of iron (Fe) levels in water samples in Astambul Subdistrict obtained the lowest average value of Fe levels in Kelampaian Tengah Village, which is 0.114 mg/l with a decrease of 0.43 mg/l (0.43%) compared to before treatment by processing using rice husks. These results are by the quality standard which is below 2 mg/l. The value after the test using the dick is better than the treatment. However, the treatment was able to reduce Fe (best dose husk 0.6 (66% husk) 1.8 (60% husk), and 2.4 (56%).

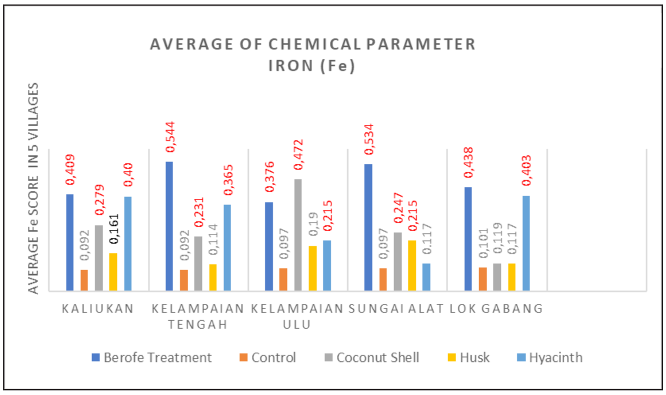

Figure 6. Average Fe Score in Five Villages

Mangan (Mn)

Testing of manganese (Mn) levels in water samples in Astambul Subdistrict found that the lowest average value of manganese (Mn) levels was found in Sungai Alat Village, which was 6.4 mg/l.

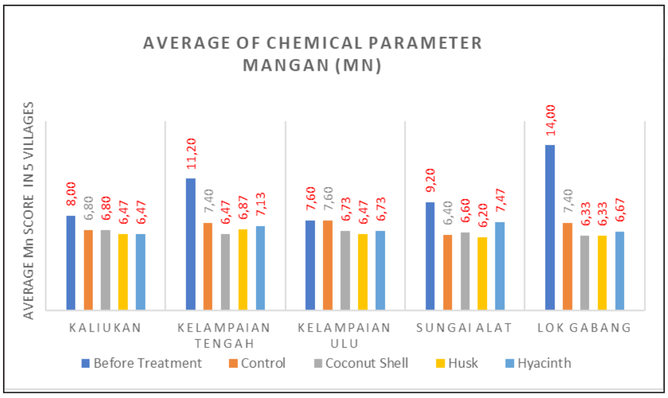

Figure 7. Average Mn Score in Five Villages

The highest average decrease in manganese (Mn) levels in water is in Lok Gabang Village with treatment using coconut shells and husks with a total decrease of 7.67 mg/l (55%). However, the manganese (Mn) level is still not by the standard because it is more than the quality standard of 0.1 mg / l . The value after the test using the dick is better than the treatment. However, the treatment was able to reduce Mn (the best dose of husk was 0.6 (23% husk) 1.8 (20% shell), and 2.4 (23% husk and hyacinth).

The differences in the results of water quality measurements before and after treatment in this study using the t-test can be seen in the following table.

Table 4. t-test Results of Physical and Chemical Parameters in the Treatment Using Coconut Shells

Parameter	df	Sig.	Description
TDS	4	0.964	There is no difference in the mean before and after treatment
DO	4	**0.037***	**There is a difference in the mean before and after treatment**
Turbidity	4	**0.013***	**There is a difference in the mean before and after treatment**
TSS	4	**0.002***	**There is a difference in the mean before and after treatment**
pH	4	0.634	There is no difference in the mean before and after treatment
Fe	4	0.075	There is no difference in the mean before and after treatment
Mn	4	0.054	There is no difference in the mean before and after treatment

Table 5. t-test Results of Physical and Chemical Parameters in the Treatment Using Husk

Parameter	df	Sig.	Description
TDS	4	0.912	There is no difference in the mean before and after treatment
DO	4	**0.003***	**There is a difference in the mean before and after treatment**
Turbidity	4	**0.016***	**There is a difference in the mean before and after treatment**
TSS	4	**0.043***	**There is a difference in the mean before and after treatment**
pH	4	0.052	There is no difference in the mean before and after treatment
Fe	4	**0.002***	**There is a difference in the mean before and after treatment**
Mn	4	**0.04***	**There is a difference in the mean before and after treatment**

Table 6. t-test Results of Physical and Chemical Parameters in the Treatment Using Water Hyacinths

Parameter	df	Sig.	Description
TDS	4	**0.002***	**There is a difference in the mean before and after treatment**
DO	4	**0.003***	**There is a difference in the mean before and after treatment**
Turbidity	4	**0.008***	**There is a difference in the mean before and after treatment**
TSS		**0.015***	**There is a difference in the mean before and after treatment**
pH	4	0.498	There is no difference in the mean before and after treatment
Fe	4	0.092	There is no difference in the mean before and after treatment
Mn		0.059	There is no difference in the mean before and after treatment

DISCUSSION

Discussion of Physical Quality Treatment of Clean Water in Five Villages

DO (*Dissolved Oxygen*)

Dissolved Oxygen (DO) testing on water samples in Astambul Subdistrict obtained the lowest DO level value in Kaliukan Village, which is 5.33 mg/l with processing using husks and the highest DO level value in Kelampaian Tengah, which is 6.97 mg/l with processing using water hyacinth. The average DO level in Astambul Subdistrict is classified as normal, namely 4.1 mg/l and by the water used for sanitary hygiene needs, namely with a standard of 4 mg/liter according to Permenkes No. 82 of 2001 (Kelampaian Tengah, Kelampaian Ulu, Lok Gabang, Sungai Alat, and Kaliukan).

Water hyacinth plants have rapid regeneration power because the vegetative pieces carried by the current will continue to grow (29). Water hyacinth is very sensitive to conditions where the nutrients in the water are insufficient, but its response to high nutrients is also large. The process of rapid regeneration and its tolerance to the environment is large enough to cause water hyacinth to be utilized as an environmental pollution control.

The results of the DO examination with natural materials show that all materials can increase DO, namely coconut shells 40% (from an average of 4.1 to 5.5), husks 33% (from an average of 4.1 to 5.1), water hyacinth 70% (from an average of 4.1 to 7.8). This is because all natural materials contain active ingredients that can improve the quality of clean water. Plants and waste materials commonly found in the environment can serve activated carbon, such as charcoal and ash. They can adsorb gases and specific chemical compounds or demonstrate selective adsorption characteristics. This capability depends on factors like pore size, volume, and surface area (30). Activated carbon possesses a high absorption capacity, ranging from 25% to 1000% of its weight. While activated carbon is frequently utilized to reduce organic contaminants and synthetic organic chemical particles, it also proves effective in mitigating inorganic contaminants such as radon, mercury, and other toxic metals.

Natural resources like water hyacinth and moringa, as well as residual materials from community activities like rice straw, husks, coconut fibers, coconut shells, and market charcoal, each offer advantages in enhancing water quality. The chemical composition of coconut shells and coconut fibers is as follows: cellulose 26.60%, lignin 29.40%, pentosan 27.70%, extractive solvent 4.20%, uronic anhydride 3.50%, ash 0.62%, nitrogen 0.11%, and water 8.01% with pyroligeous acid, gas, charcoal, tannin and potassium. Rice husk contains lignocellulosic materials like other biomass and contains high silica. The chemical content of rice husk consists of 50% cellulose, 25%-40% lignin, and 15%-20% silica, crude protein 3%, crude fiber 32.56%, fat 1.33%, Neutral Detergent Fiber (NDF) 67.34%, Acid Detergent Fiber (ADF) 46.40%, and hemicellulose 26.62%. The content of active ingredients contained in water hyacinth is composed of 60% cellulose, 8% hemicellulose, and 17% lignin. These results are in line with the research from six doses tested on coconut shells, water hyacinth, and husk materials, it can improve water quality if a dose of 0.6 grams on the husk can increase DO from 6.4 mg/liter to 6.8 mg/liter, a dose of 1.8 grams on the husk raises the pH from 6 mg/liter to 6.5 mg/liter, a dose of 2.4 grams on coconut shells can reduce from 256 mg/liter to 183 mg/liter (7).

DO levels are in line with low TDS and TSS levels in the waters of Astambul Subdistrict. If DO is according to the standard, TDS is also appropriate and TSS is also according to the standard and low. This states that the average DO level in Astambul Subdistrict is quite good with TDS and TSS values that meet the standards so that it is good for the development process of living things for breathing, metabolic processes, or exchange of substances which then produce energy for growth and reproduction.

TDS (*Total Dissolved Solid*)

According to the regulations, the average total dissolved solid (TDS) value for water used in sanitary hygiene must be less than 300 mg/L. All sampling points had TDS levels within this limit. TDS includes dissolved materials (diameter 10-6 mm) and colloids (diameter 10-6 mm – 10-3 mm) in the form of chemical compounds and other substances that cannot pass through a filter paper with a diameter of 0.45 μm (31).

TDS is typically caused by inorganic materials in the form of ions, which are commonly found in water bodies such as seawater, which also contribute to elevated salinity and electrical conductivity (EC). Elevated TDS levels in water indicate the effects of rock weathering, soil runoff, and the impact of domestic waste (32). If not properly managed and treated, high levels of TDS can contaminate water bodies. Additionally, it can harm aquatic life and negatively impact human health due to the presence of high concentrations of chemicals such as phosphates, surfactants, ammonia, and nitrogen, along with elevated levels of suspended and dissolved solids, turbidity, BOD5, and COD (32). The maximum TDS level set by the Indonesian Minister of Health No. 2 of 2023 is < 300 mg/L for water used for sanitary hygiene.

The results of water testing in the Astambul Subdistrict area show that the water sources there are not heavily polluted, either naturally occurring or the result of human activities. Since the TDS levels are well below the maximum threshold, it is likely that there is no industrial activity near the sampling location that discharges its waste into the water. Some samples were also taken from residents' wells so that they are better protected from pollution from waste. Although the water collection location has many agricultural areas, it is likely that farmers still use natural ingredients to fertilize their plants without using chemical fertilizers.

Turbidity

Turbidity is closely linked to the level of suspended matter because it is caused by particles floating in the water. These suspended substances can include inorganic materials like fine sand, clay, and natural mud, as well as organic materials. Organic suspended substances may consist of compounds such as cellulose, fat, and protein, or microorganisms like bacteria and algae. These materials originate from both natural sources and human activities, including industrial, agricultural, mining, and household activities. While turbidity results from suspended substances in the water, the relationship is not always directly proportional due to the varying shapes and specific gravities of these particles (33).

Turbidity values suggest that river water is unsuitable for consumption. This turbidity is caused by suspended materials in the water, such as soil, mud, and other organic substances. During rainfall, surface runoff carries these suspended sediments from the land into the river (6). Turbidity refers to the reduction in water clarity caused by the presence of collonial and suspended particles, including mud, organic and inorganic substances, and aquatic microorganisms (34).

There is a direct relationship between suspended solids and turbidity. Increased levels of suspended solids lead to higher turbidity values. However, elevated levels of dissolved solids do not consistently result in increased turbidity. For instance, seawater typically has high levels of dissolved solids but may not exhibit high turbidity. The average turbidity level is still below the maximum threshold set. The water from the sampling points is still quite clear, especially that taken from residents' wells. This is because the water in the wells does not move or flow so that the existing material can settle. The bottom of the water is dominated by mud so that it settles more easily. The low turbidity level in Astambul Subdistrict is related to the low TDS as well. The turbidity level of water can be reduced by adsorbing and reducing movement to facilitate sedimentation (35-36).

TSS (Total Suspended Solid)

Total suspended solid (TSS) is a solid contained in water and is not a solution, this material is distinguished from dissolved solids using laboratory filtration tests. The unit is mg/l. TSS consists of settleable, floating, and non-soluble components (colloidal suspension). TSS typically contains organic and inorganic compounds. One characteristic of TSS is that it is associated with turbidity characteristics and the corresponding DO value.

The results of TSS testing meet the feasibility of water used for sanitary hygiene according to Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023. The results of TSS examination with natural materials show that all materials can increase, namely coconut shells 98% (from an average of 5.6 down to 34), 96% husk (from an average of 5.6 down to 0.25), 64% (from an average of 5.6 down to 1.7).

Discussion of Chemical Quality Treatment of Clean Water in Five Villages

pH

Based on the figure above, it can be seen in the graph of water after being given the addition of rice husk-activated carbon shows that there is an increase in pH in all villages that are the subject of the study. The highest increase in pH is 0.37 gr/l (5.7%) compared to before treatment in Kelampaian Tengah Village. This is because functional groups can form on activated carbon from rice husks after activation. These functional groups induce chemical reactivity on the surface of activated carbon, influencing its adsorption characteristics. During the production of activated carbon, surface oxidation generates hydroxyl, carbonyl, and carboxylic groups. These groups confer amphoteric properties to carbon, enabling it to exhibit both acidic and basic characteristics, thereby aiding in the adjustment of water pH (37).

In addition, rice husk contains silica. About 20% silica in rice husk is a fairly high source of silica and has a small amount of other undesirable elements (impurities) compared to its large amount of silica. Silica is obtained from burning the husk to produce ash or by extraction as sodium silicate with alkaline solutions and is capable of neutralizing the pH (37-38).

Iron (Fe)

Rice husk is a form of agricultural waste that has a hard layer of wrapping on the grain cariopsis, consisting of two hemispheres called lemma and palea that are interlocked. The agricultural waste can be further processed into useful by-products in addition to the main product. The chemical content contained in rice husks consists of cellulose which functions as an absorber of hazardous materials. Activated carbon in rice husk is useful as an adsorbent in wastewater treatment to remove various types of heavy metals and in gas treatment to remove CO_2. An adsorbent is a substance that has selective adsorption power, is porous, and has a strong binding force to the substance to be physically or chemically separated. The ability of an adsorbent to adsorb depends on the pore size and size of the material being adsorbed. Organic components include carbohydrates dominated by cellulose and hemicellulose (37,39). These compounds can bind pollutants dissolved in water as an adsorption medium and trap ferrous metal ions (37,40).

In addition, the decrease in iron (Fe) levels in water is also related to the increase in water pH value. If the pH increases, the content of heavy metals such as Fe will precipitate so that the Fe content in the water decreases (41-42) Based on the results of pH measurements, it can be seen that after being given the addition of activated carbon from rice husks there is an increase in pH in all villages. These results are in line with the results of measuring the value of Fe content in water which also shows that the treatment using rice husks can reduce Fe levels in water in all villages that are the subject of research in Astambul Subdistrict.

Mangan (Mn)

Coconut shell media as activated carbon functions as an absorber to absorb including absorbing heavy metals such as Mn and Fe substances, so that polluted water will go through the pores in activated carbon and then inhibit silt in groundwater. Coconut shells as activated carbon are very effective in purifying and absorbing odors, tastes, and toxins in water. Activated carbon from coconut shells contains silica which functions to remove iron content, remove a little manganese (Mn^{2+}) and yellow color in groundwater or other water sources (43).

Rice husk media can also function as an absorber because it has chemical content such as cellulose which functions as an absorber of hazardous materials. Activated carbon in rice husk is useful as an adsorbent in wastewater treatment to remove various types of heavy metals and in gas treatment to remove CO_2. An adsorbent is a substance that has selective adsorption power, is porous, and has a strong binding force to substances to be physically or chemically separated such as heavy metals (37).

In addition, the decrease in manganese (Mn) levels in water is also related to the increase in water pH value. If the pH of the water increases, the content of heavy metals such as Fe and Mn will precipitate so that the content of heavy metals in the water decreases (44). Based on the results of pH measurements, it can be seen that, after the addition of activated carbon from rice husks, it shows that there is an increase in pH in all villages that are the subject of the study. These results are in line with the results of measuring the value of manganese (Mn) content in water which also shows that the treatment using rice husks can reduce manganese (Mn) levels in water in all villages that are the subject of research in Astambul Subdistrict.

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CONCLUSION

Based on the results of the study, it can be seen that natural materials such as coconut shells, husks, and water hyacinth have the potential to improve water quality using physical, chemical, and microbiological quality indicators. Based on the t-test, it is known that there is an average difference in the measurement results of physical and chemical parameters before and after treatment. So it can be seen that natural materials such as coconut shells, husks, and water hyacinths have the potential to improve the physical and chemical quality of water. This research is expected to be used as a basis for the community to utilize natural materials to improve water quality.

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