

UTILIZATION OF GAMBIR PLANT (*Uncaria gambir*) FOR DIRTY WATER TREATMENT

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Abstract

Water pollution is one of the major environmental problems currently faced, primarily due to domestic, agricultural, industrial, and mining waste. To address the predicted clean water crisis in 2045, effective, affordable, and environmentally friendly water treatment innovations are needed. This study aims to explore the potential of the gambir plant (*Uncaria gambir*) as a natural ingredient for purifying dirty water. Gambir is known to contain active compounds such as tannins, flavonoids, and catechins that have coagulant, antibacterial, and adsorbent properties. The research method used a quantitative and experimental approach, with steps such as extracting gambir leaves, treating dirty water, and observing physical changes in the water. The results showed that within two hours, gambir extract was able to significantly reduce the turbidity, odor, and color of dirty water. The addition of natural filters made from betel and lemon strengthened the final results. The conclusion obtained is that the use of gambir for dirty water treatment shows promising effectiveness and is worthy of being developed as an alternative solution for water resource management in the future.

Keywords: *Gambir; water treatment; tannin; water pollution; adsorption; coagulation*

Introduction

Water pollution in Indonesia is a serious problem and continues to attract public attention. In 2025, most major rivers in Indonesia will still experience soaring pollution, with approximately 76% showing alarming levels. This is due to the presence of many hazardous substances that can damage human, animal, and plant ecosystems. The main sources of pollution are domestic, agricultural, and industrial waste, including mining waste. This pollution causes various health and environmental problems. Domestic waste, including household waste, human waste (feces), and wastewater from daily activities, can contaminate water with bacteria and organic compounds. Agricultural waste results from the excessive use of fertilizers and pesticides, which can cause chemical pollution in water, especially in rivers and irrigation channels. Industrial waste comes from factories and other industrial activities, such as the discharge of waste containing hazardous chemicals into rivers and the sea. Mining waste occurs because mining activities produce waste that pollutes water, which can occur through soil erosion and mineral leaching.

Indonesia ranks third worst in the world in terms of sanitation according to WHO (World Health Organization) data. Many areas, especially in rural areas and densely populated areas, still discharge domestic wastewater directly into the environment without treatment, potentially polluting water sources and endangering public health. Population growth and urbanization also influence the high volume of domestic wastewater. Without adequate treatment systems, this can lead to serious environmental pollution. Modern industry naturally produces liquid waste containing hazardous substances. If not properly treated, this waste can pollute rivers, lakes, and groundwater, threatening public health and ecosystems. Experts from IPB University stated that Indonesia could face a clean water crisis by 2045 due to land conversion and water source pollution. Effective wastewater treatment is one solution to address this problem. The impacts of water pollution are numerous, including health issues, resulting in a variety of illnesses, such as diarrhea, skin diseases, and other serious diseases. This is because water pollution can disrupt aquatic ecosystems, disrupting the food chain. This is undoubtedly significant, as it can disrupt agricultural and fisheries activities and reduce the quality of drinking water. It will also significantly impact the ecosystem, especially the habitats of aquatic animals, and disrupt the ecological balance.

One potential alternative solution is the use of local plants that have the ability to absorb or neutralize pollutants. Gambier (*Uncaria gambir*) is a plant native to tropical regions, including Indonesia, known to contain catechin and tannin compounds. These compounds have antibacterial properties and high adsorption capacity for heavy metals and organic compounds. In the context of wastewater management, the active ingredients in gambier can be utilized as a natural coagulant agent, aiding in efficient and environmentally friendly water purification. Furthermore, gambier is easily found and cultivated in several regions of Indonesia, making it a potential local solution for widespread application. Given the serious impacts of water pollution and the urgency of environmentally friendly and easily implemented solutions, alternative approaches to wastewater management are needed. Therefore, research and development of the use of gambier plants as a natural agent in wastewater management is crucial to support environmental sustainability and future public health.

Based on the description above, this study aims to analyze the process of treating dirty water using gambier plants, including processing steps, the length of time required, the reactions caused, and the suitability of the processed results based on basic physical indicators of clean water that is safe for consumption.

Methodology

Types and Approaches of Research

This study employed a quantitative approach, an approach that emphasizes objective measurement of the variables studied through numerical data collection. The data obtained were then statistically analyzed to systematically and measurably examine the relationships, comparisons, and influences between variables. This approach was chosen because it provides an accurate picture of the effectiveness of gambier extract in wastewater treatment processes, which require quantitative data such as changes in turbidity, color, or pollutant levels in the water. Furthermore, this study employed an experimental approach, a component of the quantitative method, in which researchers directly perform specific actions or treatments on the research object under controlled conditions. In this case, the experiment was conducted through wastewater treatment practices using gambier extract as the treatment variable. This approach allowed researchers to directly observe the changes or impacts caused by gambier use on water quality.

Processing Procedure

1. Gambier Plant Extraction

- 1) Dried gambier leaves are finely ground
- 2) Dissolved in hot water to extract catechins and tannins
- 3) Filtered and dried to become a concentrated extract

2. Preparation of Dirty Water Samples

- 1) The prepared dirty water is filtered to remove solid objects in it.
- 2) Water is placed in a clear container to see the reaction that occurs.

3. Water Treatment with Gambier Extract

- 1) Gambier extract is added to dirty water
- 2) Leave it for several hours (0 – 2 hours) by stirring gently for 30 seconds.
- 3) The water is tested again after the treatment.

4. Parameters measured

The parameters measured in this study were color and odor.

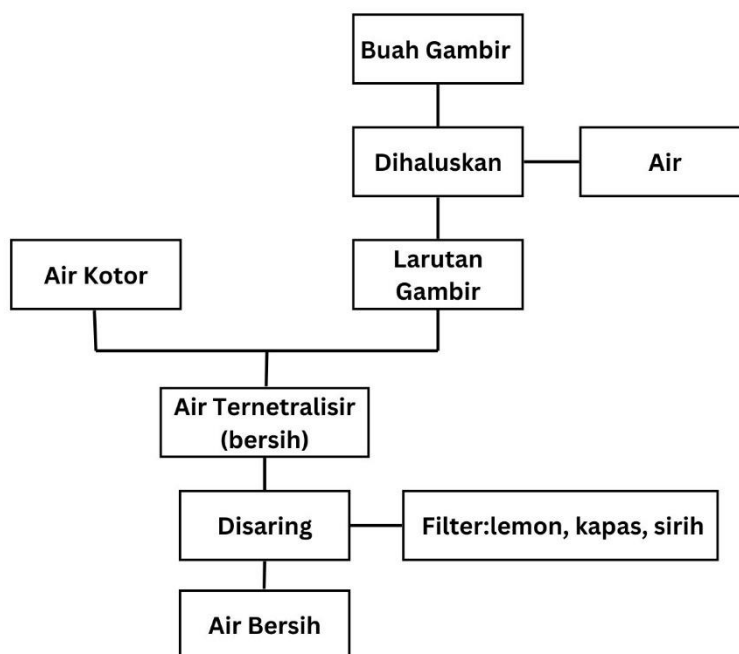


Figure 1.Processing procedure process.

1. Results and Discussion

After processing dirty water using gambier extract over time (0 – 2 hours), the results were obtained based on the table below.

TIME	REACTION	COLOR	SMELL
0	Dirty/Muddy	Brown to gray	Iron/mineral smell
1	Starting to clear	White (cloudy)	Fades iron/mineral odor
2	Clear	White	Neutral (no aroma)
After Filtering	The water which was originally clear after 2 hours, became increasingly clear, resembling water.		

Table 2.Reaction Results.

The table above shows that water left for 2 hours is clear white and odorless (neutral). Furthermore, the filtration process using natural ingredients such as lemon, betel leaf, and cotton contributes to sterilization and a high level of hygiene. This has the potential to reach a suitable consumption level, with convincing physical indicators. However, it's recommended for use in household activities like washing clothes, bathing, and so on. Water purified with gambier extract cannot be directly consumed. Even though it looks clean again, this does not mean that water that has gone through the purification stage using gambier extract can be consumed directly. However, it can be used for washing clothes and general household activities. The results of the experiment, dirty water can be turned into clean water that is suitable for use only by using natural ingredients that are still easy to find in some areas, even the ingredients used are still often consumed by some people who are not aware that the plant is actually useful for water purification, the plant is gambier which in fact contains active compounds such as catenine, tannin, and flavonoids. These compounds are accompanied by antibacterial, antioxidant, coagulant, adsorbent (absorption) properties. After the process of treating dirty water to be clean with gambier extract, it is followed up with a process of natural ingredients such as betel and lemon as neutralizing ingredients made in the form of filters, these materials are selected based on the content in the plant.

Lemons contain citric acid which helps lower the pH of water, Vitamin C functions as a powerful antioxidant to help eliminate harmful chemicals, Potassium helps eliminate toxins, Flavonoids have anti-bacterial properties. Betel leaves contain eugenol which can help kill bacteria and microorganisms, alkaloids can remove toxins in water, saponins have the ability to eradicate dirt and germs in water. From the research results, it is explained that the time needed to purify dirty water takes 2 hours, this shows that the active substances in gambir such as tannins need time to function optimally, tannins themselves also have an optimum point where the decrease in water turbidity will weaken when it is at its optimum limit, but most of the suspended particles have been successfully flocculated and settled, but it must be remembered that contact time affects the decrease in the number of microorganisms in the

water, the longer the water is soaked using gambir water, the more microorganisms will be eliminated, this is due to the antibacterial content in tannins and this can be neutralized again using a filter that also contains good antibacterials and antioxidants. Thus, water can be better for use in daily activities, because the particles and dirty content that are not removed when using gambier extract can be neutralized using a filter that has been made from lemon, betel leaf, and cotton. Because the water content and particles still remain and settle in the water after the process of adding gambier extract to dirty water, a filter with the addition of lemon, betel leaf, and cotton is needed to filter and neutralize the good content of particles in dirty water that has been added to gambier extract. Therefore, with an alternative approach to treating wastewater, a new method using gambier and a natural filter made from lemon, cotton, and betel, the general public can use this method to reduce the wastewater deficit. This will allow them to conserve water for household activities that are not directly consumed.

Conclusion

- 1) Gambier plant extract has an effect on dirty water, resulting in reduced turbidity in the water and improving the color and odor of the dirty water produced after adding gambier extract.
- 2) The longer it is left with the reaction of the gambir extract which relies on tannin, the clearer the water that is determined in the bottle containing dirty water (according to the time level).
- 3) The use of gambier as a coagulant and adsorbent is a natural, environmentally friendly and economical method.

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