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Original Research

DETERMINATION OF ALKALINITY AND CHLORIDE IN WELL WATER BEFORE AND AFTER PURIFICATION USING TITRATION METHOD

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ABSTRACT

Determination of Alkalinity and Chloride in Well Water Before and After Purification Using Titration Method. *This study aims to determine the levels of alkalinity and chloride in well water before and after the purification process in Kampung Jaifuri, Skanto District, Keerom Regency. Well water is the primary water source for the local community; therefore, its quality needs to be evaluated to ensure its suitability for daily use. The parameters analyzed in this study were alkalinity and chloride levels as important indicators of water chemical quality. The method used in this research was titration. Alkalinity was determined using acid-base titration with phenolphthalein and methyl orange indicators, while chloride levels were measured using argentometric titration (Mohr method). Water samples were collected before and after the purification process to compare their quality. The results showed that alkalinity decreased from 2.64 mg/L to 2.28 mg/L after purification. Similarly, chloride levels decreased from 7.81 mg/L to 6.39 mg/L. These results indicate that the purification process was effective in improving water quality by reducing the concentration of chemical substances in the well water. In conclusion, the water purification process is effective in reducing alkalinity and chloride levels, thereby improving the quality of well water in Kampung Jaifuri. It is recommended that the community apply water purification methods before using well water for daily needs.*

INTRODUCTION

Based on Government Regulation Number 82 of 2001, water is defined as all water present above and below the earth's surface, excluding seawater and fossil water. Water is a strategic natural resource that supports human life, public health, and socio-economic development. It is extensively utilized for drinking, cooking, sanitation, agriculture, and industrial purposes, making both its availability and quality essential for sustaining human activities [23]. In developing countries, including Indonesia, daily water requirements generally range from 30–60 liters per capita[6].

Groundwater, particularly well water, remains the primary source of clean water in many rural communities because of its accessibility and relatively stable availability throughout the year [15]. However, its quality is strongly influenced by geological conditions, environmental characteristics, and human activities. Domestic wastewater, poor sanitation, agricultural runoff, and improper waste disposal may introduce contaminants into groundwater through

infiltration, causing deterioration in water quality and increasing potential health risks[11]. Therefore, drinking water quality must comply with established standards to ensure public health protection[16,18].

Water scarcity has become an increasing challenge due not only to limited water availability but also to declining water quality caused by population growth, land-use change, urbanization, and industrial development[8]. Data from the Public Works Department indicate that nearly 70% of Indonesia's population consumes water contaminated with hazardous substances, including iron, manganese, and other pollutants[22]. Although groundwater generally remains available during dry seasons, it often contains higher concentrations of dissolved minerals such as calcium, magnesium, and iron, which may affect its suitability for domestic use[3].

Water quality is commonly evaluated through physical, chemical, and biological parameters[1]. Among chemical parameters, alkalinity and chloride are particularly important. Alkalinity represents the buffering capacity of water against pH changes and is primarily determined by bicarbonate, carbonate, and hydroxide ions. Excessive alkalinity may influence water taste, chemical stability, and distribution systems[1,7,12]. Chloride is a naturally occurring inorganic ion derived from mineral weathering but may also originate from domestic waste, industrial activities, and seawater intrusion. Elevated chloride concentrations may impair water palatability and indicate groundwater contamination[14,25]. Consequently, the determination of alkalinity and chloride concentrations is essential for evaluating groundwater quality.

Various purification methods, including filtration, adsorption, and coagulation, have been developed to improve water quality by reducing suspended particles and dissolved contaminants[13]. The effectiveness of these purification processes can be evaluated by comparing water quality before and after treatment. Among available analytical techniques, titration remains widely employed because of its simplicity, reliability, and high analytical accuracy. Acid-base titration is commonly used to determine alkalinity, whereas argentometric titration using the Mohr method is applied for chloride analysis[14,24].

Previous studies have shown that groundwater quality in residential areas frequently deteriorates due to anthropogenic activities and environmental conditions, potentially affecting public health[2,10,19]. However, most studies have focused only on water quality assessment without evaluating changes occurring before and after water purification. Furthermore, studies investigating groundwater quality in Kampung Jaifuri, Skanto District, Keerom Regency, remain very limited[14].

The novelty of this study lies in the comparative analysis of well water quality before and after purification using titration methods in Kampung Jaifuri, an area that has received limited scientific attention[16]. This study is expected to provide empirical evidence regarding the effectiveness of local purification practices and contribute baseline data for groundwater quality management.

Therefore, this study aimed to determine the alkalinity and chloride concentrations of well water before and after the purification process using titration methods and to evaluate changes in water quality resulting from the purification process.

MATERIALS AND RESEARCH METHODS

This study employed a quantitative approach with a descriptive comparative design to compare the quality of well water before and after the purification process. The study was conducted in Kampung Jaifuri, Skanto District, Keerom Regency. Well water samples were collected directly from community wells before and after purification using a purposive sampling technique based on wells actively utilized by local residents. Samples were stored in clean, sealed containers prior to laboratory analysis.

Chloride concentration was determined using the argentometric titration (Mohr) method in accordance with the Indonesian National Standard SNI 6989.19:2009. This method is based on the reaction between chloride ions and standard silver nitrate ($AgNO_3$) solution to form silver chloride (AgCl), with potassium chromate (K_2CrO_4) serving as the indicator for endpoint detection[17].

The research procedure consisted of sample collection, sample preparation, and chemical analysis. Alkalinity was determined using the acid-base titration method with standard hydrochloric acid (HCl), employing phenolphthalein and methyl orange as indicators. Chloride concentration was measured using the Mohr method with $AgNO_3$ as the titrant and K_2CrO_4 as the indicator, with the endpoint identified by the solution color change[9].

Titration results were used to calculate alkalinity and chloride concentrations (mg/L). Data were analyzed descriptively by determining the mean values and percentage reduction of each parameter before and after purification. The results were presented in tables to facilitate interpretation, while purification effectiveness was evaluated based on the reduction in alkalinity and chloride concentrations.

The equipment used included a burette, retort stand and clamp, volumetric pipette, Erlenmeyer flask, graduated cylinder, beaker, funnel, wash bottle, pH meter, and analytical balance. The materials consisted of well water samples, standard sulfuric acid (H_2SO_4), standard silver nitrate ($AgNO_3$), phenolphthalein, methyl orange, potassium chromate (K_2CrO_4), and distilled water.

This method enabled the evaluation of changes in well water quality following purification and the effectiveness of the treatment process in improving water quality for community use.

Sample Preparation

A 25 mL aliquot of well water sample was transferred into a 250 mL Erlenmeyer flask using a volumetric pipette. When the sample pH was outside the range of 7–10, 1 N H_2SO_4 or 1 N NaOH was added as required to adjust the pH to the desired range.

Analysis of Alkalinity Concentration

Alkalinity was determined by titrating a 25 mL water sample with standard H_2SO_4 after the addition of two drops of methyl orange indicator. The titration endpoint was identified by a color change to orange, and the volume of titrant consumed was recorded. A blank determination was performed using 25 mL of distilled water under the same conditions, and all analyses were conducted in duplicate. Alkalinity concentration was calculated using the following equation:

$$\text{Alkalinity (mg/L)} = \frac{V H_2SO_4 \ x \ N H_2SO_4 \ x \ 1000}{Vsample}$$

Keterangan :
V H_2SO_4 : Volume of titrant consumed (mL)
N H_2SO_4 : Normality of sulfuric acid standard solution (N)
V : Volume of water sample (mL)

Table 1. Alkalinity results

Treatment	V H_2SO_4 Before Purification (mL)	V H_2SO_4 After Purification (mL)
Titration 1	6,7 mL	5,7
Titration 2	6,5 mL	5,6
Average	6,6 mL	5,7

$$Alkalinity\ before\ water\ purification = \frac{6{,}6 \ x \ 0{,}02 \ x \ 1000}{50} = 2{,}64\ mg/L$$

$$Alkalinity\ after\ water\ purification = \frac{5{,}7 \ x \ 0{,}02 \ x \ 1000}{50} = 2{,}28\ mg/L$$

Chloride Content Analysis

Chloride concentration was determined using the Mohr argentometric titration method. Twenty drops of 5% K_2CrO_4 indicator were added to the sample, which was then titrated with 0.01 M silver nitrate ($AgNO_3$) until a reddish-yellow endpoint was observed. The volume of $AgNO_3$ consumed was recorded. A blank titration was performed using 50 mL of well water filtered through the purification device under identical conditions, and all measurements were conducted in duplicate. Chloride (Cl^-) concentration before and after the purification process was calculated using the following equation:

$$\text{Chloride content} = \frac{A \times n \times 1000 \times p}{V\ sampel}$$

Notes:
A = titration value
n = normality of $AgNO_3$
p = massa

Table 2. Results of Chloride Levels Before and After Purification

Treatment	VAgNO3 used before purification	VAgNO3 used after purification
Titration 1	1,0 mL	0,8 mL
Titration 2	1,2 mL	1,0 mL
Average	1,1 mL	0,9 mL

a. Alkalinity Test

b. Chloride Test

Figure 1. Titration Results Before and After Water Clarification

Chloride content calculation before filtering using a water purifier

$$\text{Chloride content} = \frac{1{,}1 \times 0{,}01 \times 1000 \times 35{,}5}{50\ ml}$$

Chloride content = 7,81 mg/L

Chloride content calculation after filtration using a water purification device.

$$\text{Chloride content} = \frac{0{,}9 \times 0{,}01 \times 1000 \times 35{,}5}{50\ ml}$$

Chloride content = 6,39 mg/L

RESEARCH RESULTS AND DISCUSSION

The results of the water quality analysis of well water before and after the purification process in Kampung Jaifuri showed changes in the alkalinity and chloride content parameters. The measurement data are presented in Table 3.

Based on Table 1, the alkalinity level decreased from 2.64 mg/L to 2.28 mg/L, a reduction of 13.64%. This decrease indicates that the purification process was able to reduce the content of basic ions such as bicarbonate and carbonate in the water. Chemically, this can occur through filtration or adsorption processes that remove some of the dissolved substances in the water.

Table 3. Alkalinity and Chloride Levels in Well Water

Parameter	Before Clarification (mg/L)	After Clarification (mg/L)
Alkalinity	2,64	2,28
Chloride	7,81	6,39

Figure 2. Research Location

The chloride ion content in the well water samples was analyzed using Mohr's argentometric titration method. The well water samples used in this study were obtained from residents' housing area. Some of the people living in Kampung Jaifuri use well water for their clean water needs.

Mohr's argentometric titration method can be used to determine chloride content within a pH range of 7–10, using a standard $AgNO_3$ solution as the titrant and K_2CrO_4 as the indicator at the endpoint of the titration. The endpoint of the titration is indicated by the formation of a brick-red precipitate, which is the compound Ag_2CrO_4. The chemical reaction that occurs is as follows[5]:

The chloride content also decreased from 7.81 mg/L to 6.39 mg/L, a reduction of 18.18%. This decrease indicates that the purification process was sufficiently effective in reducing chloride ions, which generally originate from mineral dissolution or environmental activity. Nevertheless, the chloride value before purification was still relatively low, meaning the well water at the study site had not, in essence, undergone significant contamination.

When compared, the percentage decrease in chloride was greater than that of alkalinity. This indicates that the purification method used was more effective in reducing chloride ions than in reducing the compounds responsible for alkalinity. This difference may be attributed to the chemical properties of each parameter, in which chloride ions are more readily dissolved and bound during the purification process compared to carbonate ions. Overall, the results of this study indicate that the purification process had a positive impact on the chemical quality of the well water. However, since the initial parameter values were already relatively low, the resulting changes were not particularly significant. This shows that the well water in Kampung Jaifuri remains in fairly good condition, but still requires proper management to maintain its quality.

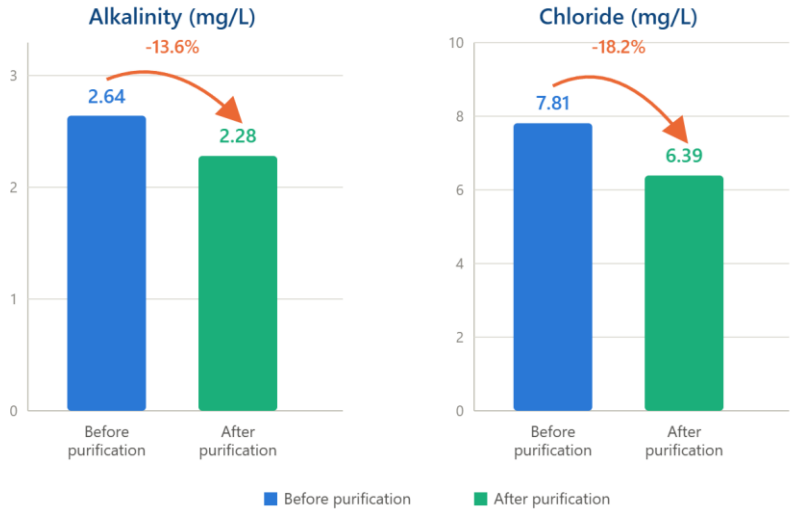

Figure 3. Changes in Alkalinity and Chloride levels before and after purification

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this study, it can be concluded that the well water samples collected from Kampung Jaifuri, Skanto District, Keerom Regency exhibited alkalinity and chloride concentrations below 600 mg/L and complied with the water quality standards stipulated in the Indonesian Ministry of Health Regulation (Permenkes RI) No. 416/Menkes/Per/IX/1990. These findings indicate that the well water is chemically suitable for domestic use with respect to the analyzed parameters. Nevertheless, routine application of the demonstrated purification method is recommended before water is used for consumption. In addition, community education programs should be implemented to increase public awareness regarding the importance of water purification and practical treatment methods. Periodic monitoring of well water quality throughout the village is also recommended as part of community health programs. Future studies should incorporate additional physical, chemical, and microbiological parameters, including pH, hardness, iron (Fe), manganese (Mn), nitrate, Escherichia coli, and total coliform, to provide a more comprehensive assessment of groundwater quality. Furthermore, spatial mapping of well water quality using a Geographic Information System (GIS) across Skanto District or Keerom Regency is recommended to support evidence-based groundwater management and public health planning.

ETHICAL APPROVAL

This study received ethical approval from the Faculty of Teacher Training and Education at Cenderawasih University, with reference number 771/UN20.111/PG/2024

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in the publication of this article. The research on determining alkalinity and chloride levels in well water before and after purification in Kampung Jaifuri, Skanto District, Keerom Regency was conducted independently, without any financial, commercial, or personal relationships that could influence the results of the study. The authors take full responsibility for the accuracy and integrity of the data presented in this study.

AUTHOR CONTRIBUTIONS

ISJ: conceptualisation and study design; MIB and FD: data collection; IYS and MLN: statistical analysis; AAL and MNRA: manuscript writing and literature review. All authors read and approved the final manuscript.

REFERENCES

1. (APHA), A. P. (2023). *Standard Methods for the Examination of Water and Wastewater.24th ed.* Washington: APHA, AWWA, WEF.
2. Association, A. P. (2017). *Standard Methods for the Examination of Water and Wastewater.* American: American Public Health Association.
3. Buana, M. (2022). *Analisis Kualitas Air Sumur Gali Dan Bor Di Kampung Bugis Kota Tarakan.* Tarakan: Universitas Borneo Tarakan.
4. Bwefar, M. I., & dkk. (2025). Analisis Kualitas Air dan Kandungan Logam Berat Timbal (PB) pada Air Laut di Perairan Pelabuhan Kelas II Jayapura Papua. *Jurnal Impresi Indonesia (JII)*, 5670.
5. D. D. Wulandari, "Analisa Kesadahan Total dan Kadar Klorida Air Di Kecamatan Tanggulangin Sidoarjo," MTPH Journal. vol. 1, no. 1, pp. 14–19, 2017.
6. Fatma, F. (2018). Kombinasi Saringan Pasir Lambat Dalam Penurunan Kadar Fe (Besi) Air Sumur Gali Masyarakat Diwilayah Kerja Puskesmas Lasikabupaten Agam. *Jurnal Penelitian dan Kajian Ilmiah Universitas Muhammadiyah Sumatera Barat*, 35.
7. Hakim, M. S., & dkk. (2023). Analisis Kadar Asiditas dan Alkalinitas pada Saluran Drainase Primer Pengeringan IV Bukit Keminting Kota Palangka Raya, Kalimantan Tengah . *IJCR-Indonesian Journal of Chemical Research*, 58.
8. Hapsari, D. (2015). Kajian Kualitas Air Sumur Gali dan Perilaku Masyarakat di Sekitar Pabrik Semen Kelurahan Karangtalun Kecamatan Cilacap Utara Kabupaten Cilacap. *Jurnal Sains dan Teknologi Lingkungan*, 2.
9. Indonesia, S. N. (2009). *Air dan air limbah – Bagian 19: Cara uji klorida (Cl-) dengan metode argentometri .* Jakarta: Badan Standarisasi Nasional-BSN .
10. Jenmau, I. S., & dkk. (2025). Analisis Kadar Logam Berat Timbal (Pb), Kadmium (Cd) Dan Merkuri (Hg) Pada Tumbuhan Air Di Danau Sentani Jayapura. *Jurnal Lingkungan dan Sumberdaya Alam (JURNALIS)* , 116.
11. Jenmau, I. S., & dkk. (2025). *Persepsi Masyarakat terhadap Kebijakan Pengelolaan Sampah Berwawasan Lingkungan.* Padang: CV. Luminary Press Indonesia.
12. Kalibrasi, P. (2024). *Uji Alkalinitas Air : Definisi, Tujuan, Manfaat, dan Metodenya.* Jakarta: Kalibrasi.com.
13. Metcalf, E. &. (2024). *Wastewater Engineering: Treatment and Resource Recovery.* New York: McGraw-Hill.
14. Nasional, B. S. (2022). *SNI Metode Pengujian Kualitas Air.* Jakarta: BSN.
15. Nasution, M. A., Amarullah2, & Thahir, M. A. (2020). Analisis Sifat Fisika, Kimia Dan Biologi Air Sumur Bor Di Lingkungan Universitas Teuku Umar. *Jurnal Perikanan Tropis* , 121.
16. Organization, W. H. (2022, Maret 21). Guidelines for Drinking-water Quality. *4th ed. Geneva:WHO*, pp. 30-31.
17. Putri, V. D., & Purnamasari, A. P. (2022). Penetapan Kadar Klorida dalam Air Danau Universitas Surabaya Secara Argentometri. *Indonesia Chemistry and Application Journal*, 34.
18. Qomariyah, A. (2022). Analisis Kadar Alkalinitas Dan Asiditas Pada Air Sumur Di Desa Tapanrejo Kecamatan Muncar Kabupaten Banyuwangi . *Fourth Conference on Research and Community Services STKIP PGRI Jombang*, 609.

19. Rusdiana, Biayatmoko, D., Chairuddin, G., & Irwan, A. (2015). Optimasi peningkatan kualitas air sumur gali menjadi bahan baku air minum dengan menggunakan kombinasi Zeolit dan Kapur Tohor. *Enviro Scienteae*, 59.
20. Singkam, A. R., Lestari, I. L., Agustin, F., Miftahussalimah, P. L., Maharani, A. Y., & Lingga, R. (2021). Perbandingan Kualitas Air Sumur Galian Dan Bor Berdasarkan Parameter Kimia Dan Parameter Fisika. *Jurnal Pendidikan Biologi dan Sains*, 157.
21. Suaka, I. Y., Widyaningsih, N., Jenmau, I. S., & Bwefar, M. I. (2025). Analisis Kualitas Air Pada Mata Air Gudang Garam Di Distrik Skanto Kabupaten Keerom. *Jurnal Pendidikan Indonesia*, 2365.
22. Sutandi, I. C., & dkk. (2011). *Laporan Penelitian Air Bersih Menjadi Air Minum PT.SUMMIT PLAST Jl.Kruing 3 Delta Silikon - Cikarang .* Cikarang: PT.Bunjamin Mitra Sejahtera .
23. Sutrisno, T., 2004. Teknologi Penyediaan Air Bersih, PT Rineka Cipta, Jakarta.
24. Syed R. Qasim, G. Z. (2017). *Wastewater Engineering: Treatment and Resource Recovery.* New York: CRC Press.
25. UNEP), U. N. (2023). *Global Environment Outlook 2023.* Nairobi: UNEP. World, B. (2023). *Water Quality and Sanitation Report.* Washington DC: World Bank.