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Microscopic Image of Calcium Oxalate Crystals in the Urine of Residents Who Consume Boiled Dug Well Water in Dampang Village, Bulukumba Regency

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Abstract

Crystals are formed about the concentration of various salts in the urine related to the patient's food metabolism and fluid intake and the impact of changes that occur in the urine after sample collection (i.e. changes in pH and temperature that change the solubility of salts in the urine and result in crystal formation). Calcium oxalate crystals are most commonly found in acidic and neutral urine. The most common form is the dihydrate form, colored crystals that resemble an envelope. This type of crystal is found in normal urine, especially after consuming large doses of ascorbic acid or foods rich in oxalic acid. This study used a descriptive research design. Urine sediment examination is one type of routine urine examination that uses a microscopic method using a microscope instrument. The results obtained from 36 urine samples of dug well water consumption showed 5 samples (13.9%) positive for calcium oxalate crystals, while 31 samples (86.15%) were negative for calcium oxalate. Based on the results of the study, it showed the presence of calcium oxalate crystals in the urine of residents who consumed boiled dug well water in Dampang Village, Bulukumba Regency.

Keywords: *Calcium oxalate crystals, urine sediment, dug well water, descriptive research*

1. Introduction

The concentration of various salts strongly influences the formation of crystals in urine. This process is intricately linked to food metabolism, fluid intake, and the physiological conditions of the individual. Changes in pH and temperature after urine sample collection can also affect salt solubility, promoting crystal formation (Mongan et al., 2017). Calcium oxalate crystals, in particular, are commonly found in acidic or neutral urine and are often observed in normal conditions, especially after consuming foods rich in oxalic acid. These crystals typically appear as colored, envelope-shaped forms, which are characteristic of calcium oxalate dihydrate.

Microscopic examination of urine sediments is a vital diagnostic tool in assessing kidney and urinary tract health. This method is often performed after urine chemistry tests to identify abnormalities and disease severity. It is most accurate when conducted immediately after urine collection to avoid changes in the sample's composition. Delayed examinations can result in bacterial growth, pH alterations, glucose degradation, and structural damage to cellular components like erythrocytes and leukocytes (Mongan et al., 2017). These changes

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can compromise the reliability of the results and obscure the identification of urinary abnormalities.

In Indonesia, residents consume water from diverse sources, including dug wells, rivers, and municipal supplies. Dug well water, in particular, is a significant source of drinking water in rural areas. The mineral content of such water, including high levels of calcium and magnesium, has been linked to the formation of calcium oxalate crystals in urine (Arisandi, 2019). Prolonged consumption of mineral-rich water can lead to urinary calcium hyperexcretion, increasing the risk of supersaturation and crystal formation. These findings highlight the importance of monitoring the mineral composition of drinking water in communities reliant on such sources.

The quality of drinking water directly impacts public health, as emphasized by the World Health Organization (WHO) guidelines. WHO (2010) recommends that individuals consume around 2 liters of safe, clean drinking water daily. Safe water should be free of contaminants, colorless, odorless, and devoid of hazardous substances. In regions like Dampang Village, where dug well water is widely consumed, it is critical to ensure that the water meets these safety standards. Boiling water is a common practice to eliminate microbial contaminants, but it does not remove dissolved minerals, which can still pose health risks.

The Indonesian Ministry of Health has established stringent guidelines for drinking water quality through Regulation No. 492/Menkes/PER/IV/2010. This regulation specifies physical, chemical, microbiological, and radioactive parameters that water must meet to be deemed safe for human consumption. Adherence to these standards is crucial in preventing waterborne illnesses and conditions associated with mineral imbalances, such as urinary crystal formation. Public awareness campaigns and regular water quality assessments are necessary to promote compliance with these regulations in rural and urban areas.

Dug well water in Dampang Village is primarily consumed after boiling, a method widely practiced to kill pathogens. However, the boiling process does not address the high mineral content inherent in such water sources. As a result, residents may still be exposed to risks associated with calcium oxalate crystallization in urine. Previous studies have linked high calcium and magnesium concentrations in drinking water to an increased incidence of urinary tract stones (Arisandi, 2019). This underscores the need for comprehensive water treatment methods, such as filtration, to remove dissolved minerals effectively.

Microscopic examination of urine samples from Dampang Village residents has consistently revealed the presence of calcium oxalate crystals. These findings corroborate earlier studies showing a strong association between mineral-rich water consumption and crystal formation (Mongan et al., 2017). Such examinations are essential in identifying early signs of urinary tract conditions and providing timely interventions. The presence of crystals in urine highlights the potential health risks faced by communities dependent on untreated or minimally treated water sources.

Dietary habits also play a significant role in the formation of calcium oxalate crystals. Consuming foods rich in oxalates, such as spinach and rhubarb, can increase the likelihood of crystallization in individuals already exposed to mineral-rich water. Proper hydration and a balanced diet are critical preventive measures that can reduce the risk of crystal formation. Encouraging the consumption of adequate amounts of water helps dilute urine, thereby lowering the concentration of salts and preventing crystallization.

The public health implications of these findings are substantial, particularly for rural communities like Dampang Village. Access to safe drinking water remains a significant challenge in many parts of Indonesia, where residents rely on natural water sources. The continued consumption of untreated or inadequately treated water can exacerbate the prevalence of urinary tract disorders. Community-based interventions focusing on water safety and hygiene education are necessary to address these risks and improve overall health outcomes.

Government policies and local initiatives must work hand in hand to improve water quality in rural areas. Investment in water infrastructure, such as filtration systems and proper storage facilities, can significantly reduce the risk of waterborne diseases and crystal formation. Public health authorities should prioritize routine monitoring of water sources and provide residents with resources to treat and test their drinking water effectively. These measures are critical in safeguarding the health of communities dependent on dug well water. Further research is needed to explore the long-term health impacts of consuming mineral-rich water in rural Indonesia. Studies focusing on the prevalence of urinary tract stones and other related conditions can provide valuable insights into the extent of the issue. Collaborative efforts between researchers, local governments, and community organizations are necessary to implement effective solutions. Such initiatives can pave the way for sustainable health improvements and ensure the safety of drinking water for future generations.

In conclusion, the microscopic presence of calcium oxalate crystals in the urine of Dampang Village residents underscores the importance of addressing water quality issues. While free of microbial contaminants, boiled dug well water often contains high mineral concentrations that can lead to urinary crystal formation. This study highlights the need for enhanced water treatment practices, public health education, and government regulations to mitigate these risks. By addressing these challenges, communities can achieve better health outcomes and reduce the prevalence of urinary tract disorders.

2. Methods

This study uses a descriptive research design. Urine sediment examination is one type of routine urine examination, namely a type of examination that uses a microscopic method and a microscope instrument.

2.1 Research Procedure

The research procedure involves the utilization of various tools and materials to ensure accurate and reliable results. The tools required include a microscope, centrifuge, centrifuge tubes, sample pots or urine collection containers, glass slides, cover glasses, dropper pipettes, and a tube rack. The materials used in this study consist of urine samples, tissues, label paper, and hand gloves. These items are essential for conducting the urine sediment examination controlled and systematically.

2.2. Work procedures

2.2.1 Pre-analytics

The pre-analytic phase begins with patient preparation, where the purpose of the research is explained to potential subjects or patients. Patients are then provided with a labeled sample container for urine collection. For sample preparation, the urine samples must

be protected from contamination by using clean and dry collection containers. Each sample is identified with the patient's name and age, and morning urine is used for the collection method to ensure consistency and reliability.

2.2.2. Analytics

The analytic phase starts with gently homogenizing the urine sample. Approximately three-quarters of the sample is transferred into a centrifuge tube, which is then centrifuged for 5 minutes at a speed of 1500–2000 RPM. After centrifugation, the supernatant is carefully discarded by inverting the centrifuge tube without causing vibration. The sediment is then resuspended by shaking the tube. A drop of sediment is placed on a glass slide, covered with a cover glass, and observed under a microscope. The Small Field of View (SFV) is examined using 10x magnification, while the Large Field of View (LFV) is analyzed at 40x magnification (Kurniawam, 2014).

2.2.3. Post Analytical

In the post-analytic phase, the results are interpreted and categorized as either negative or positive. A negative result is indicated as (-) 0/LPK. Positive results are further classified as (+1) for 1–4/LPK, (+2) for 5–9/LPK, and (+3) for >10/LPK. Finally, the inspection results are reported and documented systematically.

2.3. Data analysis

The data analysis carried out for this study was carried out using the SPSS program, in the form of a frequency distribution, where the numbers are presented in table form and then analyzed.

3. Results and Discussion

This research was conducted in the laboratory of the Panrita Husada Bulukumba Health Sciences Institute on July 24-30, 2024, which can be shown in the primary data table of the examination results as follows:

Table 1. Frequency distribution of respondents based on gender

No	Gender	Frequency	Percentage(%)
1	Man	10	28%
2	Woman	26	72%
	Total	**36**	**100%**

Based on table 1, the results of respondent data based on gender are obtained, namely from a total of 36 respondents, it shows that there are 10 people (28%) of male respondents and 26 respondents (72%) of female respondents.

Table 2. Description of the results of the calcium oxalate crystal research

Interpretation of Results	Frequency	Percentage(%)
Positive	5	13.9%
Negative	31	86.1%
Total	**36**	**100%**

Based on table 2, shows that in the examination with a sample size of 36 samples, in the urine of those who consumed dug well water, 5 people (13.9%) were found to be positive for calcium oxalate crystals, while 31 people (86.1%) were negative for calcium oxalate crystals.

Table 3. Frequency distribution of respondents based on age

No.	Age	Frequency	Percentage(%)
1	<45	21	58.3%
2	>45	15	41.6%
	Total	**36**	**100%**

Based on table 3, the results of respondent data based on age are obtained, namely from a total of 36 respondents, it shows that respondents under the age of 45 years are 21 (58.3%) and respondents over 45 years are 15 (41.6%).

Table 4. Frequency distribution of respondents based on length of consumption

No.	Duration of consumption	Frequency	Percentage(%)
1	<1 year	0	0
2	1-5 years	0	0
3	5-10 years	0	0
4	> 10 years	36	100%
	Total	**36**	**100%**

Based on table 4, the results of respondent data are obtained based on the duration of consumption, namely from a total of 36 respondents, the duration of consumption was predominantly more than 10 years.

Urine crystals are one of the inorganic elements in urine, Crystals commonly found in urine sediment are calcium oxalate crystals. Based on research conducted at the Stikes Panrita Husada Bulukumba Laboratory on 36 urine samples, 5 people were positive and 31 people were negative.

People who consume well water are found to have five positive calcium oxalate crystals due to consuming well water continuously and for a long time containing lime grains. Water that contains high hardness if consumed continuously can form urine sediment crystals because the body has imperfect filtration. Positive calcium oxalate oxalate crystals are usually also due to consuming high doses of ascorbic acid or foods rich in oxalic acid.

The presence of crystals in the urine can indicate a disturbance in kidney function. In addition, the formation of crystals in the urine also indicates a predisposition, including infection, which can allow the emergence of a disease often referred to as kidney stones. A disease characterized by the formation of kidney stones in the urinary tract, which can cause

epithelial cell fragments to peel off. The formation of stones in the urinary tract can be accompanied by the presence of urine crystals. (Margatan, 2013)

Calcium oxalate crystals in urine are also influenced by the consumption of foods containing calcium and phosphorus, citric acid and uric acid and the habit of drinking less than 1.5 liters/day. People who have a habit of drinking less than 1.5 liters/day have a greater risk of experiencing the formation of calcium oxalate sediment in their urine. (Reni Yunus & Tuty Yuniarty, 2016)

Urine sediment or microscopic examination of urine is a follow-up examination after urine chemistry examination, which is important to determine abnormalities in the kidneys and urinary tract and the severity of the disease. This sediment examination usually uses morning urine or random urine, after collecting urine, an examination is immediately carried out. For delays in urine examination, a preservative should be given because there will be changes in the composition of substances and the results released such as bacterial growth, decreased glucose levels, alkaline pH, cylinder decomposition, erythrocyte lysis, changes in leukocyte shape/damage, urine becomes increasingly cloudy, changes in color and odor, and nitrite becomes positive (H. Hardjooeno and Fitriani, 2007)

To maximize the reading of urine sediment, the tools used should be in good condition such as the object glass and microscope. Dirty object glass cannot be used to read urine sediment because of the presence of dirt or fungi that resemble blood cells. The microscope is the main tool in this urine sediment research. The microscope used must have a clean lens free from dust and fungi because it can affect the field of view when examining urine sediment under a microscope. (R. Gandasoebrata., 2004)

Dug well water is one of the sources of clean water supply for people in rural and urban areas. Dug wells provide water that comes from layers of soil that are relatively close to the surface of the ground, therefore it is easily contaminated through seepage from human waste, animals, or for domestic household needs. Dug wells as a source of clean water must be supported by construction requirements, and location requirements for the construction of a dug well, this is necessary so that the quality of dug well water is safe by the rules set.(Katiho et al., 2016)

Dug wells are a water source that is widely used by the Indonesian people, approximately 45%. For well water to meet health requirements as household water, well water must be protected from the dangers of contamination. Prevention that can be done to prevent the formation of Ca oxalate crystals is by consuming water that is suitable for consumption, water that is boiled and filtered first before drinking, by drinking lots of water it can come out when urinating.(Consumer et al., 2023)

Conclusion

Based on the results of the study, showed the presence of calcium oxalate crystals in the urine of residents who consumed boiled dug well water in Dampang Village, Kediri Regency. Bulukumba.

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Conflict of Interest

The authors declare no competing interests

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