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Original Article

Determination of calcium levels in water samples in East Penfui Village, Central Kupang, Kupang Regency

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ABSTRACT

Kidney stones (nephrolithiasis) are a disorder of the calyx or renal pelvis that can cause kidney function damage due to the blockage of the urinary tract. Stone formation is caused by an increase in calcium, oxalate, and uric acid in the body or a decrease in citrate as a substance that inhibits stone formation. Microscopic analysis of urine may show blood, pus, or tiny stone crystals. Additional tests that can help make the diagnosis include 24 h urine collection and blood sampling to assess levels of calcium, cystine, uric acid, and other substances that can cause stones. The incidence of nephrolithiasis patients in Kupang, East Nusa Tenggara, has increased every year. It is necessary to examine the calcium levels in water sources which may cause stone formation in the kidneys. This study aims to determine the calcium (Ca) levels in water samples in East Penfui Village, Central Kupang, Kupang Regency. The research was conducted in a laboratory using a true experimental randomized control group approach, with samples from three water sources in East Penfui Village, Central Kupang, Kupang Regency. The results of the colorimeter examination showed that the mean level of calcium from the three water sources was 29.21 mg/L. Therefore, it can be concluded that the calcium level in the water sources consumed by the residents in East Penfui Village is above the maximum standard level of Ca that is allowed in accordance with the Decree of the Minister of Health of the Republic of Indonesia, which is 10 mg/L.

Keywords: Nephrolithiasis, calcium, kidney

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INTRODUCTION

Kidney stones (nephrolithiasis) are a disorder of the calyx or renal pelvis that can cause damage to the kidney function due to blockage of the urinary tract. If the blockage lasts for a long time, the urine will flow back into the kidneys, thus the kidneys may experience increased pressure due to the increased amount of urine precipitation. Stone formation is caused by an increase in calcium, oxalate, and uric acid in the body or a decrease in citrate as a substance that inhibits stone formation.[1]

Oxalate and calcium can increase urinary calcium oxalate supersaturation. Hyperoxaluria accounts for 10–50% of calcium stone forming. Hyperoxaluria is caused by excessive oxalate production due to metabolic disorders, increased intestinal oxalate absorption, increased food intake and bioavailability, and urine pH.[2] Very acidic (pH 5.5) and very alkaline (pH 6.7) urine can affect calcium stone formation. If the pH is too acidic, the urine becomes saturated with uric acid, which plays a role in the crystallization of calcium oxalate. Very alkaline urine may increase the formation of monohydrogen phosphate, which in combinationwith calcium may reacts thermodynamically unstable into brucite, which eventually formed into hydroxyapatite.[3,4]

Stones that do not cause symptoms may be discovered accidentally on a routine urine analysis examination (urinalysis). Microscopic analysis of urine may exhibit the presence of blood, pus, or small stone crystals. Usually, no other tests are necessary unless the pain persists for more than a few hours or the diagnosis is uncertain. Additional tests that can help establish the diagnosis are 24 h urine collection and

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blood sampling to assess levels of calcium, cystine, uric acid, and other substances that can cause stones. An abdominal X-ray may show the presence of calcium stones and struvite stones. Other tests that may need to be done are intravenous urography and retrograde urography.[5,6]

The incidence of cases with kidney stones in East Nusa Tenggara is increasing every year, thus, it is necessary to conduct an in-depth study to determine the screening in areas with quite a several cases of kidney stone in East Penfui Village, Central Kupang, Kupang Regency.

MATERIALS AND METHODS

For this study, a sample of drinking water sources was collected from three different points in East Penfui Village, Central Kupang, Kupang Regency.

Subsequently, the samples were carried out in an assay using colorimetric techniques.[7] The calcium (Ca) level was measured with Elabscience Calcium (Ca) Colorimetric Assay kit 96T according to the manufacturer's instruction.

The procedure began by diluting 200 μL of sample solution with 4.5 ml of cold PBS solution and centrifuged at 3000 rpm. Subsequently, 4 ml of the supernatant was collected and placed into a new 10 ml tube.[8]

After that, a 1 ml of 15% TCA solution was added into the solution. Moreover, another tube was prepared with 0.25 N HCl, and then, 0.37% TBA solution was added. The solution was then heated in an 800°C – water bath for 15 min, cooled at room temperature for 60 min, and the sample was then centrifuged at 3000 rpm for 15 min.[7-9]

After centrifugation, the supernatant was collected to measure its absorbance using a spectrophotometer. The wavelength of spectrophotometer was set at 610 nm, especially for calcium (Ca). The calcium level was calculated using the regression line equation from the standard curve of the Ca solution.[7,9,10]

RESULTS

As Table 1 has shown, the level of calcium found in all three points of drinking water sources was relatively higher than the maximum standard level of Ca allowed. Indeed, in all the three replications of each sample, the level of Ca was well above 10 mg/L.

DISCUSSION

The calcium content in drinking water may be affected by the soil structure in East Penfui Village, which contains many calcium rocks such as coral.[11] The presence of these rocks causes contamination when the water is in the ground, therefore, when it comes out through the springs, the water contains high levels of calcium.[12]

Table 1: The level of calcium found in three points of drinking water sources in East Penfui Village, Central Kupang, Kupang Regency

Sample	Replication	Rate (mg/L)
Sample 1	Replication 1	19.86
	Replication 2	22.75
	Replication 3	21.30
Sample 2	Replication 1	15.10
	Replication 2	17.42
	Replication 3	17.55
Sample 3	Replication 1	49.29
	Replication 2	50.20
	Replication 3	49.44
Mean		29.21

*The maximum standard level of Ca that is allowed in accordance with the decree of the Minister of Health of the Republic of Indonesia is <10 mg/L

Calcium intake in the human body can indeed increase the risk of kidney stones, although it is not known how much exposure and the time it takes for kidney stones to form.[12,13] Research conducted by Taylor *et al*. (2004)[9] showed that 80% of kidney stone disease was caused by calcium intake, and most of it was calcium oxalate. About 80% of kidney stones are formed from calcium oxalate and calcium phosphate, 10% by struvite (magnesium ammonium phosphate and bacteria), 9% by uric acid, and 1% by cystine and ammonium acid. The formation of kidney stones is predicted to be due to an unwanted phase shift mechanism in which these materials change from a liquid to a solid.[14]

Calcium can be the cause of the formation of kidney stones; this can be seen through the calcium content in the patient's urine.[12] A study was conducted by Curhan *et al*. (1999)[14] where they evaluated the urine of patients with kidney stones chemically and recorded that 200 mg/L of calcium were found in the urine of patients with kidney stones. Furthermore, Najem *et al*. (1997)[8] in their research on stressful events in life and the risk of kidney stone symptoms, it was concluded that kidney stones were caused by calcium, protein, salt, oxalate, and phosphate. In addition, kidney stones may also due to the low consumption of fluids, citrates, magnesium, fiber, and alcohol.[14] Another study also concluded that obesity and weight gain would also increase the risk of kidney stone formation, and the magnitude is higher in women than in men.[5,8]

Heller *et al*. (1998)[11] stated that calcium intake would gradually increase the formation of kidney stones. In fact,

they noted that a good calcium intake is recommended in a normal population because it will reduce the prevalence of bone fragility. However, it is necessary to increase fluid consumption and limit salt, oxalate, and animal meat.[11,14]

CONCLUSION

This study has concluded that the level of calcium in the drinking water source used by the community at East Penfui Village is well above the maximum standard level of Ca that is allowed in accordance with the decree of the Minister of Health of the Republic of Indonesia, which is 10 mg/L.

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CONFLICTS OF INTEREST

There are no conflicts of interest found during this study.

REFERENCES

1. Donatelle, RJ. Health: The Basics. 6th ed. San Francisco, USA: Pearson Education Inc.; 2005.
2. Dana J. Removing Beerstone. Modern Brewery Age. Birko Corporation R and D; 1998.
3. Moe OW. Kidney stones: Pathophysiology and medical management. Lancet 2006;367:333-44.
4. Goldfarb DS, Fredric L. Prevention of recurrent nephrolithiasis. Am Family Physician 1999;60:2269-76.
5. Taylor EN, Stampfer MJ, Curhan GC. Obesity, weight gain, and the risk of kidney stones. J Am Med Assoc 2005;293:455-62.
6. Coe FL, Evan A, Worcester E. Kidney stone disease. J Clin Investig 2005;115:2598-608.
7. Curhan GC, Willet WC, Speizer FE, Stampfer MJ. Twenty-four-hour urine chemistries and the risk of kidney stones among women and men. J Kidney Int 2001;59:2290-8.
8. Najem GR, Seebode JJ, Samady AJ, Feuerman M, Friedman L. Stressful life events and risks of symptomatic kidney stones. J Epidemiol 1997;26:1017-25.
9. Taylor EN, Stampfer MJ, Curhan GC. Dietary factors and the risk of incident kidney stones in men: New insights after 14 Years of follow-up. J Am Soc Nephrol 2004;15:3225-32.
10. Leonetti F, Dussol B, Berthezene P, Thirion X, Berland Y. Dietary and urinary risk factors for stones idiopathic calcium stones formers compared with healthy subjects. J Nephrol Dial Transplant 1998;13:617-22.
11. Heller JH. The role of calcium in the prevention of kidney stones. J Am Coll Nutr 1999;18:3731-9.
12. Curhan GC, Willet WC, Speizer FE, Stampfer MJ. Intake of Vitamins B6 and C: The risk of kidney stones in women. J Kidney Int 1999;59:2290-8.
13. Curhan GC, Willet WC, Knight EL, Stampfer MJ. Dietary factors and the risk of incident kidney stones in younger women. J Arch Intern Med 2004;164:885-91.
14. Curhan GC, Willet WC, Speizer FE, Stampfer MJ. Comparison of dietary calcium with supplemental calcium and other nutrients as factors affecting the risk of kidney stones in women. J Am Soc Nephrol 1999;126:497-504.