

# Potency of Suri Cucumber Juice (*Cucumis sativus*) as a Solvent for Calcium Oxalate Kidney Stones ( $\text{CaC}_2\text{O}_4$ )

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This study explores the potency of Suri Cucumber Juice (*Cucumis sativus*) as a Solvent for Calcium Oxalate Kidney Stones ( $\text{CaC}_2\text{O}_4$ ). Calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) is a compound that forms kidney stones roomates clog and interfere with kidney function. Potassium in the voltaic series is located to the left of calcium, so it will be easy to get rid of calcium by reaction with oxalate, so that plants with high potassium have the potential to decay kidney stones. Suri cucumber plants (*Cucumis sativus*) contain potassium salts and other compounds—potentially it can dissolve calcium oxalate ( $\text{CaC}_2\text{O}_4$ ). The purpose of this research is to prove that suri cucumber juice (*Cucumis sativus*) can dissolve calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) in vitro. This type of research is experimental with a quasi-experimental research design. The independent variable is the length of time of immersion in suri cucumber juice (*Cucumis sativus*), and the dependent variable is the solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ). Subjects in the study used were calcium oxalate which was immersed in a solution of suri cucumber juice (*Cucumis sativus*) for four days. Repetition is done four times. Examination of dissolved calcium levels in suri cucumber juice (*Cucumis sativus*) uses the Complexometry method. Data analysis used the One-Way ANOVA test followed by the Bonferroni test. Place of research is in the laboratory of the Health Analyst in the Polytechnic of Tanjungkarang. The results showed that suri cucumber juice (*Cucumis sativus*) was able to dissolve calcium oxalate deposits ( $\text{CaC}_2\text{O}_4$ ). The length of time of immersion in suri cucumber juice (*Cucumis sativus*) influences the increase of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) solubility with p-value of  $<0.05$  roommates is 0.017. The optimal dissolution of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) is 32.24%, which is on the 4th day.

**Key words:** *Calcium Oxalate, Solubility, Suri Cucumber Juice.*

## Introduction

Kidney stone disease is a urological disorder, and nephrolithiasis is one of the most common urinary tract disorders (Landry et al, 2015), The average prevalence rate worldwide reaches 1-12% of the population who suffer from kidney stones (Hasanah, 2016). Each year more than one million cases of kidney stones are diagnosed, with an estimated 10% of people suffering from kidney stones. The formation of kidney stones in the urinary tract area is a nuisance disease that is often experienced by people (Dharma, 2015).

Kidney stones are pieces of solid material that are formed when the urine has a very high concentration. The solid material is generally formed of oxalate, calcium, and phosphate (Dharma, 2015); (Grover, PK, & Ryall, RL (1994). The formation of calcium oxalate stones increases with age and starts from the attachment of the crystals formed in the renal tubular cavity to the surface of the renal tubular epithelial cells (Tsujihata 2008).

The largest number of stone contains calcium oxalate, or a mixture of calcium phosphate and magnesium ammonium phosphate, sometimes with calcium carbonate or whitish calcium oxalate. Oxalate crystals can also be derived from a rare inborn metabolic errors that primary hyperoxaluria in hyperuricaemia, usually due to gout (Baron, 2015). The most common kidney stone type is calcium oxalate formed in Randall plaque in the renal papillary surface Alelign & Petros (2018). About 80% of stones are composed of calcium oxalate and calcium phosphate; 10% magnesium ammonium phosphate produced during infection with bacteria have the enzyme urease, 9% of uric acid and the remaining 1% consists of cystine or uric acid ammonium acid or diagnosed as drug-related stone (Coe, FL, Evan, A., & Worcester, 2005). Too high oxalate content in foods can also interfere with kidney function. In the body will it combine with calcium oxalate to form calcium oxalate crystals.

Treatment of kidney stones can be done through various ways, namely by medical treatment and alternative medicine using herbal solutions. In the medical treatment, initial actions taken to diagnose the presence or absence of stones in the kidney and urinary tract is through laboratory tests, ultrasonography (USG), computerised tomography scan (CT Scan), and X-ray. Medical therapy for the handling of such stones can be done through various ways, depending on the location and size of the stone, as well as the renal function of patients. This type of therapy is accompanied by prescribing certain drugs which serve to destroy the stone, inhibiting stone formation. While for alternative medicine, using herbal solutions also proved to be potent for the cure of kidney stones (Dharma, 2015),

Research has been done to prevent and treat kidney stone disease. The study aimed to get an alternative way of treatment that effectively and efficiently renders the disease not harmful. Indonesia is a tropical country that has many tropical plants that have been used by the inhabitants. As an example, the District of Bangli Regency Kintamanai inventoried 47

species of medicinal plants that are believed to alleviate and even cure urinary tract disorders. Three are types of rare plants, namely: pule (*Astolnia scholaris*), purnajiwa (*Euchresta horsfieldii*) and suren (*Taona suroni* Merr) (Darsini, 2013).

Alternative medicine is used to treat kidney stone disease in the form of medicinal plants that are believed to have a diuretic effect, among others tempuyung leaves (*Sonchus arvensis* L.) (Winarto, IW, & Karyasari, 2004) and Budiharto, M., Ngatidjan, N., & Donatus, IA (2001). Frequency of use of tempuyung tea leaves (*Sonchus arvensis* L.) with 2x daily dose of calcium oxalate has a solubility greater than the frequency of use of the tempuyung tea leaves with 1x daily dose daily for 7 days in a row has finished with calcium oxalate at 27.49%. The longer the time of use of tempuyung tea leaves the greater the solubility of calcium oxalate, so there is an influence of the frequency of use of the tempuyung tea leaves to the solubility of calcium oxalate (Hidayati, A., & Anggraini, Y. H 2009). Leaves of avocado (*Persea americana* Mill) (Kristianingsih, I., & Wiyono, 2017); and leaves of nasty shard (*Strobilanthes crispus*) (Dharma, S., Aia, M., & Shukri, 2016), celery leaves (Dewi, EKM, Walanda, DK, & Sabang, SM (2007), leaves of corn (*zea Mays l*) (Ratri, W. N 2008), 70% ethanol extract of blue grapes (*Vitis vinifera* L.) may also dissolve calcium kidney stones in vitro (Nisma, F., 2011). Also, the combination of ethanol extract of leaves of the soursop (*Annona muricata* L.) and leaves of gotu kola (*Centella asiatica* L. Urb) can dissolve calcium kidney stones (Swintari et al, 2016). The content of potassium citrate as lime juice can also shed a kidney stone (Budiyanto et al (2017). The ethanol extract of leaves of month flowers (*Tithonia diversifolia*) is also capable of dissolving calcium kidney stones (Triyasmono, L., & Suhartono, E., 2019).

The plant contains a lot of potassium and flavonoids that can destroy urinary tract stones, and as a diuretic or kidney stone laxative. According to research conducted by (Hidayati, A., & Anggraini, 2009) and (Jewel, Lift, and Wahyuni, 2017), it is stated that the plant having a high potassium content has a good solubility of the calcium oxalate. Several animal studies have also been carried out that include the ethanol extract of leaves of a red gedi are shown to inhibit the formation of kidney stones in male rats (Djamhuri, et al, 2016). Bawang Dayak (*Eleutherine Palmifolia* (L) Merr) as missiles and kidney stones in male white rats (Arnida, A., & Sutomo, 2016). Garcinia cambogia extract at a clinical level detaches calcium oxalate kidney stones from Drosophila Malpighian tubules (Fan et al, 2019).

These herbal treatments present a problem for people who do not like plants which have a bitter taste, because most of these herbs taste bitter. So, we need alternative plants that can solve the problem. Fruit is a better herbal alternative because it has a sweet taste or is just slightly acidic. Watermelon is one of the fruits that can be used as the alternative, because the red watermelon (*Citrullus vulgaris rubrum*) and yellow watermelon (*Citrullus vulgaris flavum*) are nutritious, act as urine laxatives, and are used to dissolve kidney stones. It is based on research conducted by (Effendi, EM, & Wardatun, 2017), confirming the solubility

of calcium oxalate kidney stones at a concentration of 100% fruit juice by  $16.25 \times 10^{-5}$  ml/L, while the red watermelon juice for  $10.83 \times 10^{-5}$  ml/L. Based on the content of potassium, it is suspected to act as a calcium oxalate solvent: yellow watermelon contains 0.02454% potassium, and red watermelon contains 0.02093% potassium.

In addition to watermelon fruits, cucumber contains high potassium and is cheaper. Cucumber is one type of fruit which is often sold in Ramadan. Cucumber has a variety of properties as a good source of antioxidants, digestives, maintains oral health, is good for diabetics, helps the diet, accelerates the detoxification process, inhibits cancer growth, and helps control cholesterol. Of the nutrients contained in cucumber, mineral potassium has the highest portion at 1008mg/ 100 grams of fruit (Sunarjono, 2012). The content of potassium in cucumber is  $\pm 50x$  higher than watermelon. Cucumber is also not a plant or foliage that is rarely consumed, such as existing alternative treatments like tempuyung leaves, leaves of avocado and others. So the cucumber has potential as an effective and comfortable treatment for calcium oxalate kidney stones. This research goal is to decide the potential of suri cucumber juice (*Cucumis sativus*) as a solvent for calcium oxalate kidney stones ( $\text{CaC}_2\text{O}_4$ ).

## Methods

This study is experimental. The research variables consist of free variables and the dependent variable immersion time is the solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ). This research was conducted in the Laboratory of Chemical Analysis of Food and Beverage Department of Health Analyst Poltekkes Kemenkes Tanjungkarang in September 2019. Immersion time to do as much as 4 treatments is 1 day to 4 days, repetition is done 4 times. The stages of the examination as follows:

- a. Pulverising calcium oxalate
  - 1) Pipette as much as 200ml 0.5M  $\text{CaCl}_2$  solution in a glass beaker, added with a solution of 200 mL 0.5M ( $\text{CaC}_2\text{O}_4$ ) forming calcium oxalate precipitate.
  - 2) The precipitate is filtered using Whatman # 42
  - 3) Discarded filtrate and precipitated calcium oxalate is heated in an oven using the exchange rate at a temperature of  $105^\circ\text{C}$  cup to dry for 1 hour so the solids form as calcium oxalate stones. Then crushed with a mortar and sieved.
- b. Preparation of suri cucumber juice (*Cucumis sativus*) 60%.
  - 1) Weighed 300 grams of cucumber meat and blended.
  - 2) Squeezed using a flannel cloth, then added distilled water until the volume is 500 mL
- c. Calculation of polyvalent metal content is considered a 60% solution of calcium in the suri cucumber fruit juice (*Cucumis sativus*). It is used as a deduction from the actual calcium levels.
- d. The calculation is done in the actual metal content of 100 mg calcium powder calcium oxalate.

- e. Do Determination of dissolved calcium metal in suri cucumber juice (*Cucumis sativus*).
- f. Soaking cucumber juice with sediment  $\text{CaC}_2\text{O}_4$ , by:
  - 1) Weighed 100 mg of calcium oxalate powder and inserted into the Erlenmeyer flask.
  - 2) Added suri cucumber (*Cucumis sativus*) to 100 mL, this treatment is made of 4 pieces, for immersion 1 day, 2 days, 3 days, and 4 days.
  - 3) After immersion suit each day, the solution was filtered using filter paper. Then the filtrate was added excess  $\text{Na}_2\text{EDTA}$  0.05M much as 20.0 mL, 3 mL buffer plus salmiak salt and EBT indicator.
  - 4) Titrated with  $\text{MgSO}_4$  0.05M until it changes colour.
  - 5) Note  $\text{MgSO}_4$  volume used and calculated total dissolved calcium levels in suri cucumber juice (*Cucumis sativus*) is then calculated the levels of calcium in the filtrate each treatment.

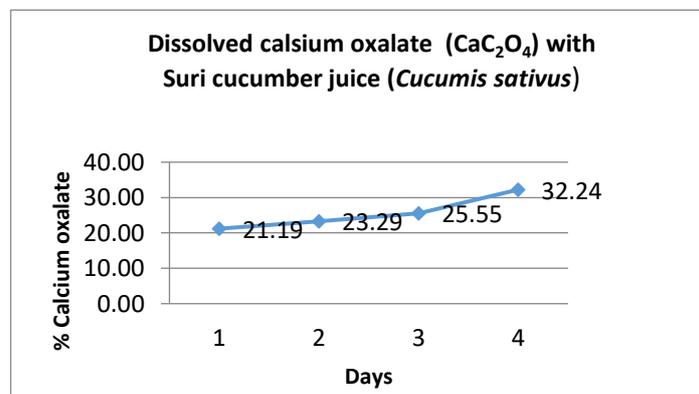
## Results and Discussion

### 1. Univariate analysis

**Table 1. Levels calcium dissolved in suri cucumber juice (*Cucumis sativus*) with soaking for 4 days**

Time (days)	Levels of calcium (%) in each repetition				Average (%)
	I	II	III	IV	
H1	10.72	23.40	26.12	24.53	21,19
H2	13.43	26.35	26.80	26.57	23.29
H3	16.83	26.57	30.65	28.16	25.55
H4	27.48	32.01	33.60	35.86	32.24

In Table 1 solubility of calcium in the suri cucumber juice (*Cucumis sativus*) is increasing from day one until the fourth repetition, marked by the increasing percentage of the level of calcium is obtained from the titration.



**Figure 1. The curve of the average increase in calcium oxalate levels ( $\text{CaC}_2\text{O}_4$ ) for 4 days**

Based on Figure 1 can be seen an average increase in significant calcium oxalate levels after 1-4 days and the most optimal time capable of dissolving calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) is on the 4th day – the time when the greatest percentage of dissolved calcium is 32.24 %.

## 2. Bivariate analysis

The results were then analysed using ANOVA test that previously tested in advance of normality and homogeneity of variance data. Then the research data continued to Anova to determine whether there is influence of suri cucumber juice (*Cucumis sativus*) on the solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) is obtained as in the following table:

**Table 2. Results of the analysis of the influence of one way ANOVA suri cucumber juice (*Cucumis sativus*) on the solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ )**

Time (days)	Average	<i>p</i> -value
H1	21.19	p = 0.017
H2	23.29	
H3	25.55	
H4	32.24	

Results of analysis of one-way Anova test was obtained p = 0.017 (p < 0.05). Furthermore, to see what time the group to significantly influence continued the analysis Post-hoc Bonferroni or least significant difference at  $\alpha = 5\%$ , which can be seen in Table 3.

**Table 3. Post-hoc Bonferroni analysis of the influence of suri cucumber juice (*Cucumis sativus*) on the solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ )**

the difference today	The mean difference	IK (95%)		<i>p</i> -value
		Min	mother	
H1 vs H2	-9.967	-	1.38	0.102
H3 vs H1	-12.177	-	-0.83	0.033
Vs H1 H4	-11 665	-	-0.32	0.042
Vs H2 H3	-2.210	-	9.13	1.000
H2 vs H4	-1.697	-	9.65	1.000
H3 vs H4	0.512	-	11.86	1.000

Based on Table 3 Post-hoc Bonferroni analysis contained p-value  $<0.05$  from group H1 to H3 is 0.033, thus providing there is significant information soaking suri cucumber juice (*Cucumis sativus*) has an effect on the solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ).

The powder of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) used in this study obtained by reacting  $\text{CaCl}_2$  with  $\text{H}_2\text{C}_2\text{O}_4$  then precipitated calcium oxalate is formed, crushed and sieved to a uniform powder particles expected solubility in the suri cucumber juice (*Cucumis sativus*) can be evenly distributed, and then dried in an oven at a temperature of  $105^\circ\text{C}$ . The precipitate is dried at a temperature so that the sediment generated remains as a calcium oxalate, because if the temperature is higher then the resulting sediment can be transformed into calcium carbonate at a temperature of  $500^\circ\text{C}$  or calcium oxide at a temperature of  $950^\circ\text{C}$  (Haryadi, 1993)

Furthermore, the determination of polyvalent metal is regarded as the calcium in the suri cucumber fruit juice (*Cucumis sativus*) and obtained content of 0.15%. These results are used as a deduction from the level of calcium in the filtrate cucumber. Furthermore, the calculation of calcium levels in the 100 mg powder of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) on titration results obtained calcium levels of 72.18%.

### 1. Univariate analysis

The solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) using suri cucumber fruit juice (*Cucumis sativus*) is checked by complexometric titration. Based on the research that has been conducted for 4 days in a row with repetition as much as 4 times as shown in Table 1 indicating increased levels of calcium oxalate dissolved growing every day and can be seen on the curve 1 the most optimum time which can dissolve calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) is at the 4th day .

### 2. The Bivariate Analysis

Based on the results of variance normality and homogeneity test data using statistical test of all treatment obtained p-value  $> 0.05$ , which means suri cucumber juice (*Cucumis sativus*) has a normal distribution and is otherwise homogeneous.

Results of analysis of one-way Anova test was obtained p-value = 0.017 or ( $p < 0.05$ ), which means that the independent variables affect the dependent variable where the length of time of immersion in suri cucumber juice (*Cucumis sativus*) affects the solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ).

Results Post-hoc Bonferroni analysis obtained from the comparison of immersion time on Day 1 to Day 3 was obtained p-value is the smallest in the amount of 0.033 or ( $p < 0.05$ ) and is a group that provides the most obvious difference between the effect of immersion suri cucumber juice (*Cucumis sativus*) on the solubility of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ).

The percentage of metal content of calcium dissolved in suri cucumber juice (*Cucumis sativus*) by soaking for 4 days in a row with repetition 4 times increased levels of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) which means that the suri cucumber (*Cucumis sativus*) has the ability to dissolve the powder calcium oxalate ( $\text{CaC}_2\text{O}_4$ ). This is because the suri cucumber (*Cucumis sativus*) has a potassium content of 1.008 mg/100gram fruit. This is a good potassium content to dissolve calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) (Sunarjono, 2012), Based on existing research watermelon is also capable of dissolving the calcium oxalate precipitate as research conducted by (Effendi, EM, & Wardatun, 2017) shows. Confirming the solubility of calcium oxalate kidney stones at a concentration of 100% fruit juice by  $16.25 \times 10^{-5}$  ml/L, while the red watermelon juice for  $10.83 \times 10^{-5}$  ml/L. Based on the content of potassium it is revealed as a solvent for calcium oxalate, yellow watermelon contains potassium 0.02454%, and red watermelon contains potassium 0.02093%.

According to research conducted by (Hidayati, A., & Anggraini, 2009) and (Jewel et al., 2017), plants that have a high content of potassium have a good solubility of the calcium oxalate, it is because potassium will compete and separate the binding of calcium with oxalate so that calcium oxalate can be dissolved. Potassium in voltaic array is located on the left of calcium, so it will be easy to get rid of calcium to react with calcium oxalate. This is because the reactivity of metal elements wane Nessa, N. (2013). Potassium is the major cation in intracellular fluid. Potassium contributes in most of the body's systems, such as cardiovascular, gastrointestinal, neuromuscular and respiratory. Potassium also contributes in maintaining the acid-base balance. Potassium is normally excreted by the kidneys, but cannot be regulated insofar as its sodium (Tamsuri 2008). Potassium is most rapidly excreted through gastrointestinal secretions. Potassium balance is regulated by the kidneys through two mechanisms, namely the replacement of the sodium ions in the renal tubular secretion of aldosterone. Aldosterone is important for regulating the concentration of potassium in the extracellular fluid. The presence of aldosterone also increases the excretion of potassium. So the conditions that increased aldosterone levels can increase urinary potassium excretion (Tamsuri, 2008).

The research results obtained are in line with research (Taslim, T and BW, 2016) where in the study avocado leaf infusion is used to dissolve the powder of calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) because it contains potassium, flavonoids and other substances capable of dissolving calcium oxalate ( $\text{CaC}_2\text{O}_4$ ). In addition, this study's results were similar to previous studies related to the solubility of calcium oxalate precipitate, among others, ability of ethanol and ethyl acetate extracts of the leaves of chives (*Allium schoenoprasum* L.) to dissolve the calcium in the kidney stones. Southwestern optimum dissolves kidney stones at a concentration of 2.5% to 51.33% and 95.53% ethanol extract of the ethyl acetate extract (Hutabalian, MR U, 2017), tempuyung leaves (*Sonchus arvensis* L.) (Winarto, IW, & Karyasari, 2004). The frequency of using tempuyung tea leaves (*Sonchus arvensis* L.) at twice daily doses has greater calcium oxalate solubility than the frequency of using tempuyung tea leaves with daily doses once a day for seven consecutive days having calcium oxalate levels of 27.49%. The longer time of

using tempuyung tea leaves the solubility of calcium oxalate is also increases, and there is an influence of the frequency of the use of tempuyung tea leaves for calcium oxalate solubility (Hidayati, A., & Anggraini, Y. H 2009). Infusion of avocado leaves and fragrant pandan leaf extract contains flavonoid and are capable of dissolving calcium stones Ginja (*Persea Americana* Mill)(Kristianingsih, I., & Wiyono, 2017). Extracts of nasty shard leaves (*Strobilanthes crispus*) affect the solubility of calcium and oxalate as a component of kidney stones in the urine. The higher the dose given, the higher the amount of dissolved calcium and oxalate in the urine (Dharma, S., Aia, M., & Shukri, 2016). Distilled water extract of leaves of avocado (*Persea americana* mill) can dissolve calcium kidney stones (Taufiq, M., 2014). The leaves contain a lot of potassium that can destroy urinary tract stones and serves as a diuretic or laxative for kidney stones. In addition to the study, ethanol and methanol extracts of moringa leaves are also able to increase the solubility of calcium kidney stones (Anas, Y et al, 2016). Further, the combination of ethanol extract of leaves of the soursop (*Annona muricata* L.) and leaves of gotu kola (*Centella asiatica* L. Urb) can dissolve calcium kidney stones (Swintari et al, 2016). The content of potassium citrate in lime juice can also shed a kidney stone (Budiyanto et al (2017). The ethanol extract of leaves of month flowers (*Tithonia diversifolia*) is also capable of dissolving calcium kidney stones (Triyasmono, L., & Suhartono, E., 2019). Many plants or leaves are able to dissolve kidney stones, however, cucumber (*Cucumis sativus*) is great as a solvent of calcium oxalate kidney stones because it is a fruit that is not as bitter as herbs; it has a sweet taste or slightly acidic.

## Conclusion

Suri cucumber juice (*Cucumis sativus*) has potential as a solvent of calcium oxalate kidney stones ( $\text{CaC}_2\text{O}_4$ ) with a p-value  $<0.05$  is equal to 0.017. The most optimal time to dissolve the calcium oxalate ( $\text{CaC}_2\text{O}_4$ ) is on the 4th day – as much as 32.24%. Further research is needed to see the effect of suri cucumber fruit juice (*Cucumis sativus*) on the solubility of calcium oxalate kidney stone types ( $\text{CaC}_2\text{O}_4$ ) derived from patients using Atomic Absorption Spectrophotometer (AAS), and further in vivo research and animal experiments.



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