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Analysis of Mineral Salt from *Daemonorops rebustus*

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ABSTRACT

Rattan (*Daemonorops rebustus*) is widely used as salt or flavoring traditionally. However, research on the mineral (anions and cations) of the ash of the rattan plant has never been reported. The purpose of this study is to determine the mineral content (anions and cations dissolved in water) contained in the rattan leaf ash by qualitative and quantitative analysis methods. The method used was the collection of lambing rattan samples in Boven Digoel district, preliminary tests of cations and anions, and then testing of cation/anion contretation from rattan. The results obtained showed that the water-soluble anions detected in the ash of rattan leaves from were chloride ions (Cl^-) of 21.02%. Meanwhile, the others cations and anions tested were not found.

KEYWORDS: Rattan emblem (*Daemonorops rebustus*), cation, anion, titration

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INTRODUCTION

Salt is a very important commodity for human life. Salt is used as a cooking ingredient that is useful as a flavoring, preservative, and can help the human digestive system. Usually in salt plus iodine which helps the body produce thyroid hormones, which are hormones that play a role in regulating the body's metabolic processes [1–3].

Natural salt contains magnesium chloride, magnesium sulfate, magnesium bromide, and other trace compounds. Salt is an ionic compound consisting of positive ions (cations) and negative ions (anions), thus forming neutral compounds (without charge). Salt is formed from the reaction of acids and bases that form neutral salt compounds [4,5]. The components of anions and cations can be organic compounds such as chlorides (Cl^-), and also organic compounds such as acetate (CH_3COO^-), as well as monoatomic ions such as fluoride (F^-), and polyatomic ions such as sulfate (SO_4^{2-}). The quality of salt depends on the level of NaCl content in salt while the NaCl content in salt depends on how concentrated the seawater will be processed into salt and the location from which the seawater is taken, in addition to the seawater factor to be processed, the crystallization site is also very [1,6,7].

Salt is usually made from seawater by various crystallization methods [8,9]. However, this is the case with the Waropko community in the Mandobo tribe of Bovoen Regency which the community uses the leaves of rattan plants (*Daemonorops rebustus*) as traditional salt called "*toot*" (meaning salty) as salt for daily life. The local community makes salt in a traditional way by taking rattan, drying it in the sun for three days until dries, weaving it into lengths, rolling it in a circle and then burning until becomes ashes. Next, the ashes are lifted and placed on the banana leaves, after cooling the ashes can be used or mixed into several processed food ingredients such as boiled potatoes, boiled meat or in the process of burning stones or barapen (food cooked in a pond filled with sweet potatoes, vegetables, meat, which is covered with leaves and hot stones)

Daemonorops rebustus is a type of rattan plant [10–12] which is important to the Waropko community. The value of this plant is usefulness as salt or traditional flavoring, but there has never been a scientific report explaining the content of this plant as a sugar. So the purpose of this study is to determine the mineral content (anions and cations dissolved in water) contained in the rattan leaf ash qualitatively and quantitatively.

RESEARCH METHODS

Ash Preparation

The rattan leaves were dried for approximately 12 days and we weighed 97 grams of the rattan. After becoming charcoal it is then pounded in a kiln at a temperature of ± 600 ^{o}C for 3–5 hours. The obtained ash is used for further analysis.

Sample Preparation for Analysis

The ashes were dried in the oven at 105^{0}C for ± 1 hour. The ash was weighed as much as 2 grams and 200 ml of aquades was added. The mixture was refluxed for 1 hour, cooled, and

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filtered. The filtrate obtained was put into used as a stock solution for subsequent analysis.

Anion Qualitative Test [13]

Chloride (Cl^-)

The sample was added $AgNO_3$ drop by drop so that a white silver chloride precipitate was formed. Furthermore, the solubility of the precipitate in HNO_3 and ammonia was tested. The sample was added with $Hg_2 (NO_3)_2$ solution, until a white precipitate was formed from Hg_2Cl_2.

Bromide (Br^-)

The sample was added with concentrated sulfuric acid to the solution, until HBr and Br_2 were formed, so that the solution will turn brown. If heated, yellow-brown smoke will come out.

Iodida (I^-)

The sample was added with concentrated sulfuric acid which will release iodine and iodic acid. The solution was added with $AgNO_3$ solution, until a yellow precipitate was formed from AgI.

Thiocyanate (CNS)

The sample was added with a solution of silver nitrate to the test solution, then a white precipitate of silver thiocyanate will be formed.

Nitrite (NO_2^-)

The sample was added with dilute sulfuric acid, until it was covered with NO gas. This gas is soluble in water and reacts with iron (II) sulfate resulting in a brown color of $(FeSO_4)_x(NO)_y$.

Sulfide (S^{-2})

The sample was added with silver nitrate to the sample solution until a black silver sulfide deposit was formed. The mixture was added with sulfuric acid or dilute hydrochloric acid, until H_2S is formed which can be recognized by its smell and black spots were formed on the filter paper moistened with lead acetate.

Carbonate (CO_3^{-2})

The sample was added with a dilute sulfuric acid solution, until a gas was formed. The mixture was added with a solution of barium chloride, until a white precipitate of barium carbonate was formed. To speed up the reaction, the solution was heated over low heat.

Phosphate (PO_4^{3-})

The sample was supplemented with a solution of barium nitrate, until a white precipitate of barium sulfate was formed.

Qualitative Cation Test [14]

Lead (Pb^{2+})

The sample was supplemented with a KI solution until a yellow precipitate was formed from the timbal odide.

Mercuri (Hg^{2+})

The sample was added with H_2S, until a white, brown and black precipitate was formed. The mixture was added with alkaline hydroxide, until a yellow precipitate was formed from mercury hydroxide.

Kuprit (Cu^{2+})

The sample was supplemented with alkaline hydroxide, until a blue precipitate was formed from the copper hydroxide. The sample was added to KI, until a white precipitate was formed from iodized copper.

Cadmium (Cd^{2+})

The sample was supplemented with a solution of ammonium carbonate, until a white precipitate of carbonate base was formed. To obtain a perfect precipitate, the solution was heated. The next sample was added with an alkaline hydroxide solution, until a white deposit of cadmium hydroxide was formed.

Chromium (Cr^{3+})

The sample was supplemented with ammonia solution, until a gray precipitate was formed from $Cr(OH)_3$.

Manganese (Mn^{2+})

The sample was added with a solution of KOH, then a white precipitate of $Mn(OH)_2$ will occur. This precipitate by the influence of air turns brown.

Nickel (Ni^{2+})

The sample was supplemented with a NaOH solution, until a green precipitate of $Ni(OH)_2$ was formed. Next, an ammonium carbonate solution was added, until a green precipitate is formed from alkaline salts.

Cobalt (Co^{2+})

The sample was added with a cold NaOH solution, until a blue precipitate was formed from alkaline salts, then heated to form cobalt hydroxide. Next, a sodium carbonate solution was added, until a red precipitate was formed from the alkaline salt.

Zeng (Zn^{2+})

The sample was added with a solution of KOH, until a white precipitate was formed from $Zn(OH)_2$. This precipitate was soluble in the excess reagent.

Calcium (Ca^{2+})

The sample was supplemented with a solution of ammonium carbonate, until a white precipitate of $CaCO_3$ was formed. Next, a solution of ammonium oxalate was added, until calcium oxalate deposits were formed.

Barium (Ba^{2+})

The sample was supplemented with a solution of potassium chromate, until a yellow precipitate was formed from barium chromate. Next, a dilute sulfuric acid solution was added, until a white precipitate of barium sulfate was formed.

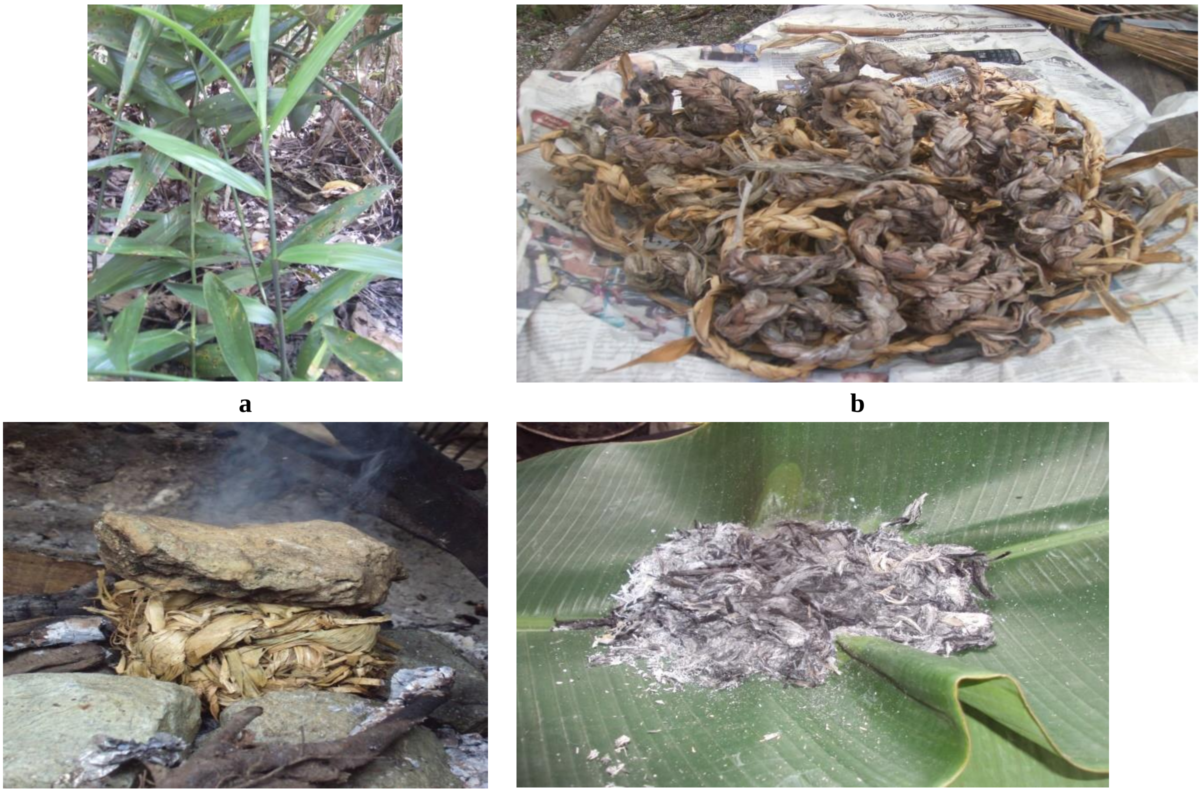
Quantitative Test of Chloride Ions (Cl^-) [13,14]

Filtrate was taken from a stock solution of 25 ml and put into 250 ml of erlenmeyer then add 10 drops of 1% K_2CrO_4 indicator. The solution was titrated with $AgNO_3$ 0.1 N until a brick-red deposit was formed, titration was repeated 3 times then recorded the volume of $AgNO_3$ 0.1 N used for titration.

RESULTS AND DISCUSSION

Ash Content Analysis

The analysis of ash content from a sample was usually carried out by weighing the ash from the excavation using a kiln at a temperature of 600^0C [15] which has been done to rattan leaf charcoal from Boven Digoel Regency. The results of the ashing from 96.76 grams of dried rattan leaf samples were obtained as much as 18.86 grams of ash. So the ash content of rattan leaves is 19.49%.



a b c d

Figure 1. Lambing rattan plants (a); Dried rattan leaves ready to be burned (b); Rattan is being burned (c), Rattan ash to be used as a flavoring (d)

Thus the ash content of the sample can be calculated as follows:

$$\text{The ash contenct} = \frac{Ash\ weight\ (gram)}{Sampel\ weight\ (gram)} x\ 100\%$$

$$= \frac{18.86g}{96.76\ g} x\ 100\% = 19.49\%$$

Qualitative Analysis of Anions and Cations

The analysis of anions and cations in rattan leaf ash samples began by dissolving a number of ash samples (2 grams) in 250 ml of hot water (reflux ash). Furthermore, the cations and anions dissolved in the hot water were identified using a special reagent.

To find out the mineral content in foodstuffs, it is usually determined by the graying method. This fogging will damage organic compounds and leave minerals behind. Some micromineral elements and salts can be lost due to ashing. Sodium chloride (NaCl) will be lost from the ash if the incineration temperature exceeds 600^0C [15]. Based on the experiments carried out, rattan ash in the kiln is carried out at a temperature of ± 600 ^{0} is added. This showed that the salt mineral content (Na and Cl) was still possible to obtain during the analysis. The ash content of rattan ash from the ash was 19.49% of 96.76 gr of charcoal sample. Ash is considered a mineral as a whole, but to find out the type of minerals (anions and cations) which is necessary to conduct qualitative and quantitative analysis of anions and cations in the sample [16]. The results of qualitative and quantitative analysis of anions and cations (Table 1) showed that the ions detected in the rattan ash sample were chloride ions. In the study, the determination of chloride levels was carried out in total.

Table 1. Qualitative test results of cations and anions contained in rattan leaf ash samples

No.	Types of cations	Test Results	Types of Anion	Test Results
1.	Lead ($Pb^{2+)}$	Negative(-)	Chloride (Cl^-)	Positive (+)
2.	Kupri ($Cu^{2+)}$)	Negative(-)	Bromide (Br^-)	Negative (-)
3.	Cadmium (Cd^{2+})	Negative(-)	Iodida (I^{2-})	Negative (-)
4.	Chrome (Cr^{3+})	Negative(-)	Thiocyanate	Negative (-)
5.	Manganese (Mn^{2+})	Negative(-)	Nitrate (NO^{2-})	Negative (-)
6.	Nickel (Ni^{2+})	Negative(-)	Sulfide (S^{2-})	Negative (-)
7.	Cobalt (CO_2^+)	Negative(-)	Carbonate (CO_2^-)	Negative (-)

8.	Zinc (Zn^{2+})	Negative(-)	Phosphate (PO_4^{2-})	Negative (-)
9.	Calcium (Ca^{2+})	Negative(-)	Sulfate (SO_4^{2-})	Negative (-)
10.	Barium (Ba^{2+})	Negative(-)		

Based on Table 1, it is known that the ions identified in the rattan ash solution sample are only chloride ions (Cl^-). The presence of chloride ions is characterized by the formation of a white precipitate when the sample is reacted with Ag^+ cations. The reaction that occurred was:

$$Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{\text{(white precipitate)}}$$

This was suspected because the content of mineral salts contained in rattan ash that is easily soluble in water is chloride salts. Other undetected salts are likely to be water-soluble salts, such as sulfate salts or salts with relatively low levels [17].

Quantitative Analysis of Chloride Ion (Cl^-) by Volumetric Method

Quantitative analysis of Cl^- anions from samples was carried out using the titrimetric method where the chloride content in the rattan leaf ash sample was 21.02%. The determination of chloride ion levels is an important aspect that must be studied first, where it is closely related to the feasibility of making salt from rattan plants. The determination of the Cl^- ion level in the sample was carried out by the argentometry method. Based on the titration, the volume data of $AgNO_3$ 0.1 N was obtained of 14.8 mL, so that the chloride (Cl) content in rattan ash was obtained of 21.02%, or if it was calculated that the chloride mineral content in the sample was 21.02% of the weight of ash was 2 grams, then it can be said that the chloride content in the rattan ash sample is less than 50%. The reactions that occur in the titration are as follows:

$$Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{\text{(white precipitate)}}$$

$$AgCl + CrO_4^{2-} \rightarrow Ag2CrO_{4\text{ (brick red deposit)}}$$

$$[Cl^-] = \frac{\text{VAgNO3 x NAgNO3 X Ar Cl X fp}}{Sampel\ weight\ x\ 1000} x\ 100\%$$

$$= \frac{14.8\ mL\ x\ 0.1N\ x \frac{28.4g}{mol} x\ 250/25}{2g\ x\ 1000} x\ 100\% = 21.02\%$$

But quantitatively what is determined is chloride anions because the element chloride shows the most meaningful qualitative results compared to the analysis of other anions and cations. Quantitatively, the chloride content in the rattan ash sample was 21.02%. The content of ions as minerals in food has an important role both in metabolism, growth and development of the human body. Chloride is one of the most important ions for the body because it was the anion that plays the most role in maintaining electrolyte balance [18].

Cl or chlorine is included in the microelements in the soil and is usually found in plant fertilizers. So if the nutrients from this plant are high, it means that the Cl element in the soil is high. The absorption rate is directly proportional to the concentration of Cl in the soil solution. Cl uptake by plants is metabolically controlled, sensitive to temperature and metabolic inhibitors. In green tissue plants, the application is magnified by irradiation. ATP is formed during photosynthetic phosphorylation as an active source of absorption energy. The effect of competition with other ions NO_3 and SO_4 can inhibit the absorption of Cl. Cl absorption is also negatively correlated with pH and is influenced by other elements [19,20].

Micronutrients in plants usually function as a constituent of plant tissues, then as regulators of acid levels, affect redox reactions in plants, as catalysts, affect osmotic values in plants and help plant growth. Meanwhile, to be more specific, the function of the chlorine element or Cl is to play a role in stimulating enzymes to affect the absorption of water in tissues and enhance the yield of plant quality [21]. But if a plant lacks chlorine, it can cause disruption of the transpiration process in plants and will make the plant dry out [20].

In addition, Cl in plant tissues is also needed in the process of Assimilation of N in plants and plays an essential component of the enzymes nitrate reductase and nitrogenase (N2 fixation enzyme). Another role is as an activator of enzymes that can decompose water in the process of photosynthesis. Nutrients such as Cl and water can be absorbed by the surface of the root hair cells through the process of time flow, root interception events and diffusion events. Nutrients can be absorbed due to the following factors, namely the phytochemical properties of ions and due to interactions between ions. The distribution of nutrients in the leaf shoots is influenced by the transpiration process because basically if an organ has a high transpiration rate, the nutrient content contained in it will be more. For aquatic plants, basically the main nutrient absorber is the leaves [22,23].

Chlor is used by our body to form HCl or hydrochloric acid in the stomach. HCl has the use of killing germs of disease germs in the stomach and also activates pepsinogen into pepsin [3]. Chloride levels often fluctuate along with sodium levels. This is because sodium chloride, or salt, is a major part of the blood. The acid-base balance in the blood serum must be maintained so that every organ of the body can carry out its duties [24]. If the acidity (pH) is not balanced, for example too acidic or too alkaline, certain minerals will easily settle. This can result in the formation of kidney stones, uric acid deposits in the joints, and others [25,26]. Blood contains 0.9% NaCI. Humans need about 200-500 mg of sodium daily to keep blood salt levels normal, so that the body stays healthy. Sodium is also important for muscle and nerve function [27–30].

CONCLUSION

From the results of the study, it was concluded that the anions dissolved in the water detected in the ash of rattan leaves from Boven Digoel district were chloride ions (Cl^-). Some types of cations tested in the aqueous solution of rattan leaf ash were not detected using a typical reagent in this study. The main anion content of minerals dissolved in water from the ash of rattan leaf samples is chloride ions, which is 21.02%.

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