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Physicochemical Characterization of Concentrated Mineral and Magnesium Isolate of Sea Water Pamekasan Madura

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ABSTRACT

Seawater contains many types of minerals that can be used in the health sector as raw materials for medicines and supplements. In Indonesia, one of the biggest mineral salt-producing areas is Pamekasan Madura with a recent record income of 2,768,809.95 tons. The many mineral resources available and the potential development of medicinal raw materials, it is necessary to check the initial physicochemical properties as a source of information for further research. This study aims to analyze the content, and physicochemical properties of concentrated minerals and magnesium isolates from seawater Pamekasan Madura. After analyzed, it was found that the concentrated mineral contained as many as 25 types of minerals and has a viscosity of 15 mPa.s, a specific gravity of 1,318 - 1,330 with a Baume value of 35-36, and pH of 6.1. The highest mineral concentrations are Sodium (32948.8012 mg / L), Magnesium (20685.5644 mg / L), and Calcium (349.7602 mg / L). Mineral concentrations of seawater Pamekasan Madura were found to be greater than the surface waters of Taiwan Yes Mineral. Magnesium isolate has a purity of 10.88%. Based on the result, it can be concluded that seawater Pamekasan Madura is a potential source of raw material for mineral medicines.

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INTRODUCTION

Indonesia is a maritime country with 75% of the total territory. The sea area (inland waters, islands and territorial sea) is 3,351 million km^2, the waters of the Exclusive Economic Zone and the continental shelf are 2,936 million km^2. The length of the coastline of Indonesia is approximately 99,093 km (Badan Informasi Geospasial, 2017). The total number of villages recorded has a salt-raising business of 493. It is the smallest number compared to other types of businesses located in the seaside area with total salt production in 2015, around 2,768,809.95 tons (Central Bureau of Statistics, 2018). Seawater contains many types of minerals. The mineral content with the highest amount is Sodium, Magnesium, Potassium, Calcium and Boron (Mero, 1965). The mineral content in Indonesia seawater has a higher level than seawater in Egypt, China, India, Singapore and Uganda (Apriani *et al.*, 2018).

Minerals have an important role in maintaining human physiological and metabolic conditions.

There have been many studies on the health benefits of seawater, including cholesterol, cardiovascular, atherogenesis, blood pressure, obesity, diabetes, hepatic, skin, fatigue, gastritis, osteoporosis, and cataracts (Nani *et al.*, 2016). Seawater minerals have been reported to have a protective effect against exercise-induced muscle damage (Hou *et al.*, 2013). Iron contained in seawater minerals also correlates to increased levels of faecal immunoglobulin A (IgA), which represents an increase in immune function (Shiraishi *et al.*, 2017). The use of concentrated minerals as a product has also been widely commercialized, for example, Sea M.D-Anderson Health Solution, Revell Global-Concentrated mineral Drop, dan ISLANDS brand Ocean Mineral Topical Facial Serum.

Based on the commercial potential and benefits of seawater concentrate mineral, which can be processed into a source of medicinal raw materials, this research was conducted to characterize concentrated minerals and magnesium isolates from Pamekasan Madura seawater.

MATERIALS AND METHODS

Materials

The materials used in this study were Pamekasan Madura seawater, Aquabides, Calcium Chloride, 1,4-dioxane, 65% Nitric Acid, standard Mg, Filter Paper.

Extraction of Concentrated minerals from seawater

The concentrated mineral was made through a natural evaporation process in a salt pool in a greenhouse. The draining of seawater was gradually carried out until the Concentrated mineral was obtained with a BE value of 36. The process of extracting the concentrated mineral can be seen in Figure 1.

The mineral content was determined using ICP-OES (PlasmaQuant PQ 9000 Series, Analytikjena, Germany). A sample of 200 mL was measured for viscosity and pH.

Magnesium Isolation from Concentrated minerals

Isolation of magnesium was carried out by precipitating sulfate ions through the addition of a calcium chloride solution producing calcium sulfate deposits. The solution was filtered using filter paper. The filtrate was then evaporated at 35°C for 24 h to remove some of the potassium ions as a potassium-magnesium double salt (KCl $MgCl_2.6H_2O$) so that a solution consisting of Mg and Cl ions was produced.

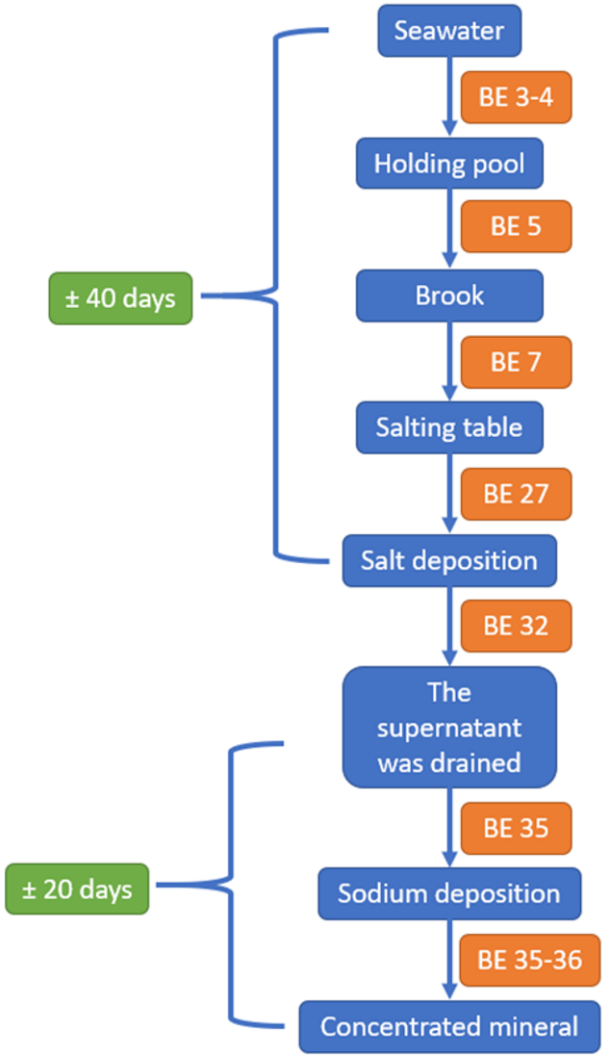

Figure 1: The extraction process of Pamekasan Madura concentrate mineral

The filtrate solution was then reacted with 1,4-dioxane ($C_4H_8O_2$) to precipitate the magnesium chloride salt to produce a precipitate of $MgCl_2.6H_2O$ $C_4H_8O_2$ (Sample).

The sample was then dried at constant temperature (100°C) to remove dioxane molecules and magnesium chloride hexahydrate $MgCl_2.6H_2O$ was produced. (Fezei *et al.*, 2012).

Magnesium Purity Analysis

Sample Preparation

The sample was weighed as much as 0.5 grams in a beaker glass. Added 3 mL of HNO_3 65%, then heated on the stove until dissolved.

The sample was cooled at room temperature, then transferred and filtered into a 100 mL measuring flask and distilled water was added to the mark. Pipette 10 μL sample into a 10 mL measuring flask and add distilled water to the mark limit.

Table 1: Comparison of the mineral content of Pamekasan Madura and Taiwan Yes seawater

No	Mineral	Concentration (mg/L)				
		Pamekasan Madura			Taiwan Yes	
		Surface seawater	Concentrated mineral	Mg isolate	Surface seawater	Deep seawater
1	Mg	14846.081	20685.5644	295.0440	1290	96100
2	Na	113431.0243	32948.8012	2241.7200	10800	7240
3	Ca	616.1930	349.7602	9.5532	411	39
4	As	1.8847	4.7652	0.0682	-	-
5	Cd	0.4440	0.5894	0.0224	-	-
6	Cr	244.7948	98.7313	0.0243	0.0002	0.087
7	Cu	2.6692	6.0440	0.0340	0.0009	0.22
8	Fe	1370.1993	436.8681	0.0672	0.003	0.25
9	Hg	<0.0001	<0.0001	<0.0001	-	-
10	Pb	5.7628	6.1788	0.0422	-	-

Preparation of Mg standard curve

Metal standard Mg series solutions were made in 0.2, 0.4, 0.6, 0.8, 1 ppm. The absorbance value of Mg standard solution was measured at 285.2 nm by Atomic Absorption Spectrophotometry (Shimadzu AA-7000, Shimadzu, Japan).

RESULTS AND DISCUSSION

Characterization and Analysis of Concentrated mineral Content

Seawater used comes from the surface of the Madura Pamekasan beach. A concentrate mineral solution was obtained with a BE value of 36. The clear solution was yellowish, salty, and odourless (Figure 2).

Figure 2: Concentrated Mineral Solution

Concentrated mineral of Pamekasan Madura has a pH of 6.1. Overall, Indonesiaseawaterer has a pH range of 6.0-8.5 (Rukminasari *et al.*, 2016). Research conducted by Mirna et al. (Apriani *et al.*, 2018) seawater of Pamekasan Madura has an average pH of 8.2. The carbon dioxide content dramatically influences the pH of seawater. Carbon dioxide forms carbonic acid (H2CO3), bicarbonate ions (HCO3-) and carbonate ions (CO3-) by reaction with seawater. Generally, the amount of organic carbon available is in the form of carbonate ions which its formation will release (H +). So that by increasing the concentration of carbon dioxide will increase the pH of the concentrated mineral.

The viscosity of concentrated mineral of the Pamekasan Madura seawater was obtained at 15 mPa.s. Seawater bittern has a viscosity of 13.2 mPa.s and a saturated $MgCl_2$ solution has a viscosity of 12.8 mPa.s (Lychnos *et al.*, 2010). This indicates that the Pamekasan Madura seawater minerals have been concentrated, especially for $MgSO_4$ or $MgCl_2$. Iseawaterer, the structure supporting salts (NaCl and MgSO4) are more available than the decomposition salt (KCl). So that by increasing the concentration of the structure supporting salt will increase the viscosity of the concentrated mineral through electrostriction and hydration (Guan *et al.*, 2015).

Based on research conducted by Mirna et al. (Apriani *et al.*, 2018) seawater of Pamekasan Madura has a BE value of 3. BE value describes the degree of viscosity of seawater. The density of the concentrated mineral is 1.318 - 1.330 g/cm^3, which was calculated using the following equation (Blair and Peffer, 1944):

$$\text{Density} = \frac{145}{145 - \text{BE}} \quad (1)$$

Magnesium Isolation from Concentrated Mineral

In Table 1, it can be seen that the mineral content

in Pamekasan Madura seawater is more than that of Taiwan Yes seawater (Sheu *et al.*, 2013). After going through deposition, the levels of some heavy metals in the concentrated mineral begin to decrease. In magnesium isolate, the content of heavy metals such as, As, Cd, Cr, Cu, Fe, and Pb decreased significantly. The purity analysis of magnesium isolates using SSA was obtained with a percentage of the Magnesium content of 10.88%.

CONCLUSIONS

The seawater of Pamekasan Madura has high mineral content. The concentrated mineral has a viscosity and density of 15 mpa.s and 1.318 - 1.330 g/cm^3. The magnesium isolate obtained has a purity of 10.88%. Based on the results, Pamekasan Madura seawater can be used as a source of raw materials for mineral medicines.

Conflict of Interest

The authors declare that they have no conflict of interest.

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REFERENCES

Apriani, M., Hadi, W., Masduqi, A. 2018. Physicochemical Properties of Sea Water and Bittern in Indonesia: Quality Improvement and Potential Resources Utilization for Marine Environmental Sustainability. *Journal of Ecological Engineering*, 19(3):1–10.

Badan Informasi Geospasial 2017. Peran Informasi Geospasial dalam Pembangunan Indonesia. *Indonesian Institute of Sciences*, 13(3).

Blair, M. G., Peffer, E. L. 1944. Thermal-density coefficients and hydrometer correction tables for vegetable tanning extracts. *Journal of Research of the National Bureau of Standards*, 33(5):341–341.

Central Bureau of Statistics 2018. Statistics of Marine and Coastal Resources.

Fezei, R., *et al.* 2012. Extractive process for preparing high purity magnesium chloride hexahydrate. *Chemical Industry and Chemical Engineering Quarterly*, 18(1):83–88.

Guan, Y., Li, J., Cheng, F., Zhao, J., Wang, X. 2015. Influence of salt concentration on DCMD performance for the treatment of highly concentrated NaCl, KCl, MgCl2 and MgSO4 solutions. *Desalination*, 355:110–117.

Hou, C. W., *et al.* 2013. Deep ocean mineral water accelerates recovery from physical fatigue. *Journal of the International Society of Sports Nutrition*, 10(1):1–7.

Lychnos, G., Fletcher, J. P., Davies, P. A. 2010. Properties of seawater bitterns with regard to liquid-desiccant cooling. *Desalination*, 250(1):172–178.

Mero, J. L. 1965. The Mineral Resources of the Sea. volume 1, page 312. Elsevier Publishing Company.

Nani, S. Z. M., *et al.* 2016. Potential health benefits of deep seawater: A review. *Evidence-based Complementary and Alternative Medicine*, pages 1–18.

Rukminasari, N., Nadiarti, N., Awaluddin, K. 2016. Effect of the degree of acidity (pH) of seawater on calcium concentration and growth rate of Halimeda sp. *Torani: Journal of Fisheries and Marine Science*, 24(1):28–34.

Sheu, M. J., *et al.* 2013. Deep seawater modulates blood pressure and exhibits hypolipidemic effects via the AMPK-ACC pathway: An in Vivo study. *Marine Drugs*, 11(6):2183–2202.

Shiraishi, H., *et al.* 2017. Effect of Minerals on Intestinal IgA Production Using Deep Sea Water Drinks. *Biological & Pharmaceutical Bulletin*, 40(10):1700–1705.