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The Content Of Metal Elements In Medicinal Plants In Dusun Mesu Desa Boto Jatiroto Wonogiri Central Java Indonesia

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ABSTRACT

This study aims to determine the content of elements of As, Hg, Mn, and vegetation analysis of medicinal plants. The research method used is survey method. Crop sampling using purposive random sampling method. Crop samples analyzed the content of As, Hg, and Mn by XRF method. The analysis was conducted on 6 types of medicinal plants. The results of XRF analysis showed that soil and plant samples contain high As, Hg, and Mn elements.

Keywords: medicinal plants, metal elements, vegetation analysis

INTRODUCTION

The research area is morphologically included in the form of volcanic hill land with an average slope of 30 º, temperatures ranging from 24-32 º C with an average rainfall of 1.845 mm / year (Figure 1.)

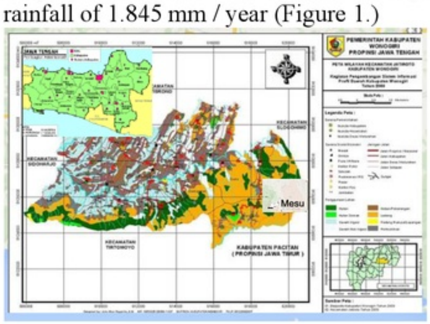

Figure 1. Map of Research Locations

Abissalam, et al. (2009), explains that based on an integrated study that includes geomorphology, stratigraphy, geological structure, petrology, alteration, and mineralization shows that this region is a fossil of ancient volcanoes. This ancient volcano was formed on the ocean floor and is part of the volcano archipelago arches. The interaction between magma, hydrothermal fluid and surrounding rocks leads to alteration and mineralization in facies of the volcano center. The mineralization process produces metal elements such as Fe, Mn, Cu, Pb, Hg, As, Zn, Ag, and other metal elements (Putranto, 2011).

The content of metal elements in nature can affect the existing vegetation. Vegetation is defined as the whole plant of an area consisting of herbs, shrubs, trees that live together somewhere, interacting with each other and with their environment (Agustina, 2008; Maryantika et al., 2010, Susanto, 2012). One type of vegetation planting plant is a medicinal plant. The definition of medicinal plants in botanical is a plant that can be used as medicine (roots, stems, leaves, flowers). Utilization of medicinal plants can be boiled by drinking water or extracted. The existence of medicinal plants is very important for the local community.

Heavy metal is a high molecular weight metal element. In low levels heavy metals are generally already toxic to plants and animals, including humans. Including heavy metals that often contaminate habitat are Hg, Cr, Cd, As, and Pb. Heavy metal is a natural component of the soil. This element can not be degraded or destroyed. Heavy metals can enter into the human body through food, drinking water, or air. Heavy metals such as copper, selenium, or zinc are needed by the human body to help the body's metabolic performance. However, it can potentially become toxic if the concentration in the body is excessive. Heavy metals become dangerous due to the bioaccumulation system, which increases the concentration of chemical elements in living organisms.

Plants containing mercury when consumed can accumulate in the body. Mercury usually enters the human body through digestion. When there is more accumulation, it can result in degeneration of nerve cells in the cerebellum that control the nervous condition, disruption to the wide view, degeneration of the neural membrane and small brain parts. This element can be mixed with enzymes in the human body causing the loss of enzyme's ability to act as a catalyst for important body functions (Setiabudi, 2005).

Death of a plant species can reduce the diversity of vegetation types in a landform. The diversity of plant species shows the diversity or variety of flora species from the lower growth, seedling, stake, pole, and tree (Syafei, 1990). Species diversity can be used to measure community stability, ie the ability of a community to keep itself stable despite disturbances to existing vegetation. According to Arrijani (2008), in general the presence of vegetation in a land form has a positive impact on the balance of ecosystems.

Based on the above description, the purpose of this study is to determine the content of metal elements to the diversity of medicinal plants and their impact on human health.

METHODOLOGY

The research method used is survey method (observation, measurement), and laboratory analysis. In the crop sampling using purposive random sampling method. This method is done by plot plot using wooden and raffia pathok with the size of plot for seedling, stake, pole, and tree respectively is 2x2 m; 5x5 m; 10x10 m; and20x20m.

Positioning and observation plot with GPS (Geographic Position System). Soil acidity level was measured using Soil Tester Takemura Eletric Works LTD. The mercury content of the soil was measured using Mercury Survey Meter Brand NIC model EMP-2.

Plants found in each observation plot were recorded by species name and number, measured stem diameter at breast height (1.3 m), and samples of plants wrapped with aluminum foil were labeled and then analyzed the content of As, Hg, and Mn with XRF (X- Ray Flourecence) at XRF Laboratory Faculty of Earth Science and Technology Bandung Institute of Technology.

Diversity / Diversity Index (H¹)

The collected vegetation data were analyzed for diversity index using Muller-Dombois and Ellenberg (1974) formulas in Suproborini(2017).

$$H^1 = -\sum_{i=1}^{S} \frac{ni}{N} \ln \frac{ni}{N}$$

H^1 = ln

Information :

H^1 = Shannon-Wiener diversity index

ni = proportion of species i

Ln = logarithmic nature

N = total number of species

With the value of H^1:

$0 \leq H^1 < 1$ = low diversity

$1 \leq H^1 \leq 3$ = Medium diversity

$H^1 > 3$ = high diversity

RESULTS

The content of soil mercury and soil pH

The results of the measurement of mercury content on the soil ranged from 0.001 to 0.044 mg / m³ and soil pH ranged from 4 to 6.8 (Table 1.)

Table 1. The content of soil mercury and soil Ph

No	Location	Soil pH	Soil Hg (mg/m³)	(ppm)
1.	Tn 1	6,0	0,004	0,000004
2.	Tn. 2	5,0	0,021	0,000021
3.	Tn. 3	4,6	0,004	0,000004
4.	Tn. 4	4,8	0,001	0,000001
5.	Tn. 5	4,8	0,002	0,000002

6.	Tn. 6	6,2	0,002	0,000002
7.	Tn. 7	5,9	0,019	0,000019
8.	Tn. 8	4,5	0,036	0,000036
9.	Tn. 9	5,0	0,003	0,000003
10.	Tn. 10	6,6	0,002	0,000002
11.	Tn. 11	5,2	0,044	0,000044
12.	Tn. 12	5,8	0,001	0,000001
13.	Tn. 13	4,4	0,036	0,000036
14.	Tn. 14	4,8	0,001	0,000001
15.	Tn. 15	5,7	0,004	0,000004
16.	Tn. 16	6,2	0,003	0,000003

Description: 1mg / m³ = 1/1000 ppm

The content ofMn, As, and Hg on Medicinal Plants

Result of analysis of Mn, As and Hg content of medicinal plants at study sites (Table 2)

Table 2. Content of Mn, As, and Hg medicinal plants

No.	Species	Mn (%)	As (%)	Hg (%)
1.	*Eugenia aromatica*	0,1143	< 0.0001	< 0,0001
2.	*Carica papaya*	< 0,0001	< 0,0001	< 0,0001
3.	*Curcuma domestica*	0,0089	< 0,0001	< 0,0001
4.	*Eugenia aperculata*	0,0057	< 0,0001	0,0149
5.	*Leucaena glauca*	0,0102	< 0,0001	0,0131
6.	*Zingiber officinale*	0,0176	< 0,0001	0,0095

Description: 1% = 10,000 ppm

Based on the results of analysis of Mn, As and Hg content in 6 species of medicinal plants (Table 2) showed Mn content ranges from <0.0001 - 0.1143%. The highest content of Mn found in *Eugenia aromatica* plant is 0,1143%. As <0.0001% content in all plant species. Hg content ranges from <0.0001 - 0.0149%. The highest content of Hg is found in *Eugenia aperculata* which is 0,0149%.

Diversity of Medicinal Plants

At the observation of vegetation at the location of the study found 6 types of medicinal plants as many as 144 individuals at the growth rate of seedlings, piles, poles, and trees. Calculation results of the medicinal plant diversity at seedling, stake, pole, and tree level in the study sites (Table 3)

Table 3. Diversity Index (H1) of Medicinal Plants at seedling, stake, pole, and tree

No.	Growth Rate	H[1]
1.	Seeds	0,68255
2.	Shurbs	0,86759
3.	Poles	0,57832
4.	Trees	0,56233

Based on calculation of index value of *diversity* (H1) at seedling level, stake, pole, and tree (Table 3) ranged from 0.56233 - 0.86759 is low.

Composition of Diversity of Medicinal Plants

The composition of plant medicinal diversity in the study sites consisted of *Eugenia aromatica, Carica papaya, Curcuma domestika, Eugenia aperculata, Leucaena glauca,* and *Zingiber officinale* (Figure 2.)

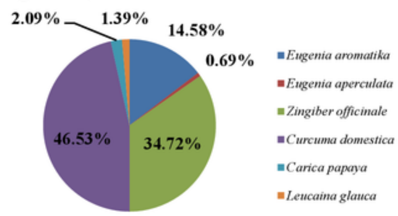

Figure 2.Composition of Diversity of Medicinal Plants

Based on the calculations (Figure 3), the highest sequence of composition of medicinal plants was *Curcuma domestica* 46.53%, Zingiber officinale 34.72%, *Eugenia aromatica* 14.58%, *Carica papaya* 2.08%, *Leucaena glauca* 1 , 39%, and *Eugenia aperculata* 0.69%.

DISCUSSION

The content of soil mercury and soil pH

According to Mirdat et al. (2013) soil mercury content is strongly influenced by soil pH. The mercury content of the soil at the study site is still below the threshold due to less than 0.5 ppm. This is in accordance with the opinion of Alloway and Ayres (1995) which states that the mercury content in the soil is said to exceed the threshold that is when more than 0.5 ppm.

The low mercury content at the study site may be due to the low clay content of the soil. This is in accordance with the opinion of Alloway (1990) which states that clay fraction is an important soil properties in absorbing metallic elements. it is also affected by soil pH (Stennis, 1990).

The low low Hg content in the soil according to Fardiaz (1992) is also due to most of the heavy metal Hg disappearing from the soil, as it undergoes methylation into the form of volatile molecules and undergoes volatilization. Methylation is usually performed by anaerobic microorganisms and can also be associated with organic acids. Methylation is the transformation of inorganic mercury into methylated organic mercury by the activity of anaerobic microorganisms.

The content of Mn, As, and Hg on Medicinal Plants

The mercury content in medicinal plants is high (<0.0001% -0.0149%) has crossed the threshold. This is in accordance with the opinion of Alloway and Ayres (1995) which states that the mercury content in the plant should be no more than 0.5 ppm.

Six types of perennials found in the research sites belong to hyperlolerant plants. This is in accordance with Widyati's opinion (2011) which states that a plant is said to have hyperolinary properties if the plant can thrive without undisturbed growth, because the plant has the ability to accumulate and translokasi heavy metals including mercury so that the growth of roots and buds does not experience obstacles

The content of mercury in *Eugenia aperculata*, *Leucaena glauca*, and *Zingiber officinale* is more than 10 ppm so that the plants are grouped in hyperacumulator plant group. This is in accordance with the opinion of Hadiani (2009), which states that mercury hyperacumulator plant is a plant that can accumulate mercury metal in a concentration of 10 ppm.

The content of Mn and As in medicinal plants in the study sites is also quite high. The high content of Mn, As, and Hg in these medicinal plants is probably due to the fact that the plant is a long-grown alteration area containing Mn, As, and Hg. Widyati (2011) states that the number of metal elements absorbed by plants depends on the type and age of the plant. It is also caused by environmental conditions, water content and nutrients at these locations that are used for the growth and development of these types of plants.

Diversity of Medicinal Plants

The low level of diversity (H^1) (0.56233 - 0.86759) (Table 6), indicates that the medicinal plant communities in the study sites have unstable levels of unstable species stability. This is probably due to environmental conditions, water content and nutrients in the soil is less able to support the growth and breeding of these plants. High species diversity shows that the community has a high complexity, because the interaction of species occurring within the community is very high. Communities are said to have low species diversity, if the community is composed by few species and if only a few species predominate (Indriyanto, 2008).

Composition of Diversity of Medicinal Plants

The highest composition of medicinal diversity was *Curcuma domestica* 46,53%, *Zingiber officinale* 34,72%, *Eugenia aromatica* 14,58%, *Carica papaya* 2.08%, *Leucaena glauca* 1,39%, and *Eugenia aperculata* 0, 69%. *Curcuma domestica* and *Zingiber officinale* have high growth rates. This is due to several factors: the environment, the water content and nutrients in these locations strongly support the growth and proliferation of these plants.

Impact of Mn, As, and Hg Content On Medicinal Plants Against Human Health

In low levels heavy metals are generally already toxic to plants and animals, including humans. Heavy metals become dangerous due to the bioaccumulation system, which increases the concentration of chemical elements in living organisms. Heavy metals can enter into the human body through food, drinking water, or air.

The effect of Mn, As, and Hg on human health (Widowati et al., 2008), as follows:

Manganese (Mn)

Mn is an essential micronutrient for humans, plants and animals. Mn toxicity usually occurs through inhalation exposure with symptoms of permanent interference of the extrapyramidal nervous system, psychiatric disorders and cirrhosis of the liver.

Arsenic (As)

As micronutrients are needed by living things, but use in large doses is toxic. As is carcinogenic, mutagenic and teratogenic. Peroral exposure may increase the risk of skin cancer, lung, bile, liver, kidney and prostate, while through inhalation can cause lung cancer. Non-cancer toxicity of As includes thickening skin, skin discoloration, stomach pain, vomiting, diarrhea, numbness of hands and feet, partial paralysis and blindness.

Mercury (Hg)

Hg forms that enter into the environment include:

1. Inorganic hg derived from rainwater or river flow and is stable at low pH. Inorganic Hg compounds, such as Hg (NO 3) HgCl2 and HGO will be accumulated in liver, kidney and brain organ. The inorganic Hg toxicity includes nervous system disorders, such as tremor, tooth failure and loss, anemia, albuminuria, and other symptoms of kidney damage and intestinal mucosal damage.
2. Organic hg such as phenyl mercury (C6H5-Hg), metal mercury (CH3-Hg) which can come from agriculture that is pesticide. The toxicity of organic mercury includes damage to the central nervous system of anorexia, ataxia, dismetria, eye disorders, blindness, convulsive hearing loss, degeneration and necrosis, neurons and coma and death.

Conclusions

1. The diversity of medicinal plants in the study sites has a low level of stability of species diversity.
2. The content of metal elements Mn, As, and Hg on medicinal plants in the study sites has exceeded the threshold.
3. Mn, As, and Hg metals contents cause health problems in humans.

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