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## RESEARCH ARTICLE

# HUMIDIFIER MODIFICATION WITH *SANSEVIERA SP.* EXTRACT SOLUTION TO DECREASE INDOOR MOLD GROWTH

\*Rusmiati, S.KM., M. Si, Rachmaniyah, SKM, M.Kes, AT.Diana Nerawati, SKM, M.Kes

Environmental Health Department, Surabaya Health Politechnic, Surabaya, Indonesia

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Mold/Fungi Number, Humidifier,  
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### ABSTRACT

This research was motivated by microbial air contamination such as mold, fungi, viruses, and bacteria. Indoor microbiological air contamination is more dangerous rather than outdoor microbial contamination. The purpose in this research was to understand the decreasing of Indoor Mold Number using Humidifier Modification with *Sansevieria sp.* Extract Solution. To understand this thing, we would count indoor mold number before and after using sansevieria extract as additional material in humidifier, next we would analyze the effectiveness of this method. Pra experiment was done by using *One Group Pre-Post Test Design*. Independent variable in this research was Sanseveira extract concentration (50%, 70%, and 100%) and dependent variable was mold number. Data was tested using paired t test and anova test. The average results in 0% concentration was 30,59 CFU/m<sup>3</sup>, 50% concentration was 24,62 CFU/m<sup>3</sup> and 70% concentration was 28,62 CFU/m<sup>3</sup>. The results showed that there was a significant difference between the mold number before and after sanseveira added. But the results of mold number in both concentrations still can not fulfill the Indonesian regulation Permenkes 1077/ Menkes/Per/V/2011, that was 0 CFU/m<sup>3</sup>. Only 100% of sansevieria extract that fulfill this regulation. The percentages of mold number decreasing in 50% concentration was 23,74%, in 70% concentration was 42,79% and in 100% it decreased until 100%. It also makes 100% concentration was the most effective to decrease indoor mold number. The conclusion from this research was Sansevieria Solution Extract can be used as additional material in Humidifier Modification to decrease indoor mold number. We recommend for the development of science and technology that are appropriate for environmental health related to the control air pollution tested to modify the Sansevieria extract solution or other extract which can also absorb pollutants.

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## INTRODUCTION

90% of our activities were done in room, it means that mostly we spent our time in indoor room rather than outdoor room. Some researches showed that indoor room contamination level were higher rather than outdoor room (Codey, 2004). Sick Building Syndrome (SBS), is a situation where occupants experience acute health and comfort issues related to the time spent in a building. Indicators of the cause are the high levels of carbon dioxide emitted by the occupants, and the formation of moisture that causes condensation where condensation occurs in the cavity of the building walls, this is what allows the fungus to grow invisible and undetected. Air pollution in a room besides being influenced by the presence of abiotic agents is also influenced by biotic agents such as dust particles, and microorganisms including bacteria, fungi, viruses and others (Fitri et al., 2017).

Long-term exposure in a moldy house is not healthy for each occupant, for people who are sensitive to fungus, inhaling or touching mold spores can cause allergic reactions, including sneezing, runny nose, throat irritation, coughing or wheezing, eye irritation, and skin rashes. Eradicating all the fungus and mold spores in the room is not easy, that's why, it is necessary to continue to make efforts to find new anti-fungi, especially from materials or plants that are easy to grow in Indonesia. One of the plants that is indicated to be an alternative as an anti-fungi is the Sanseveira plant. This is because in some studies, Sanseveira plants are known to have potential as anti-fungal substances. Aside from being an absorbent of poisons, Sanseveira turned out to have various other benefits. The benefits include: wound cover, antiseptics, hemorrhoids, smallpox, worms, eye and ear diseases, and also as a body refreshing beverages. According to OomKumala et al, 2012, the extract of the Sanseveira plant based on phytochemical tests showed the presence of saponin compounds, flavonoids, steroids, and triterpenoids that are as anti-*Candida albicans* and its leaf extracts at 90% concentration forming inhibition zones against *C. Albicans* (Komala et.al, 2012).

\*Corresponding author: Rusmiati, S.KM.,  
Environmental Health Department, Surabaya Health Politechnic,  
Surabaya, Indonesia.

The antibacterial substances in *Sanseveira* extract include flavonoids, saponins, and tannins. The content of chemical compounds that have an effect as an anti-fungal is flavonoids group. Flavonoids have several benefits in addition to being an antibacterial agent, it also can be used as an anti-fungal and antiviral agent (Cushnie, 2005). Mold on the walls is one of the problems in the house that is very disturbing aesthetically. Even though home cleaning products have been used to remove stubborn fungus, it is not yet effective in removing mold. According to Glitzmedia.Co in a humid room, a humidifier can be an alternative to reduce the humidity level of the room because this can be a step to prevent the emergence of mold. In this research, the methanol extract of *Sanseveira* was used as an anti-fungal, because it was an abundant plant and is often used as an ornamental plant by the community. The content of Flavonoids on this plant can be used as an antibacterial agent, anti-fungal and antiviral agent. These are an efforts to deal with indoor air pollution caused by fungus. Moreover, air pollution inside the room has a greater hazard than outdoors. By reducing the Number of Mold in the room we also keep it to stay remain below the applicable standards and not harmful to human health.

Based on the description above, it is necessary to do research on reducing the number of mold in the room using the *Sanseveira* extract placed on the humidifier. Humidifier is a device that serves to keep the humidity in the room. When the air is too dry, this tool will increase the level of humidity. This humidifier needs to be filled with water so that the device can spray water vapor into the entire room. The purpose of this study is to analyze the reduction in the number of molds in the room using the extract of the *Sanseveira* as a modification to the humidifier. The fundamental targeted in this study is to modified humidifier by adding *Sanseveira* extract to the humidifier solution to reduce the number of fungal in air. Several studies have been carried out related to the use of *Sanseveira* extracts (Komala, 2012), Effectiveness test of the ethanol extract of the *Sanseveira* leaves to Modified *Candida albicans*. Phytochemical tests showed that *Sanseveira* leaf extracts contain saponins, flavonoids, steroids, and triterpenoids, which can inhibit *C. Albicans*. At 90% concentration it forms the most extensive inhibition zone. The higher the concentration of the extract, the greater the inhibitory activity. From the research it was obtained that the ratio and absorption of *sanseveira* was 30 grams while the best time during the absorption process was 24 hours for 1 week. Research by Sannidya (2017) about the design of water purifiers with the concept of Eco friendly and the addition of the features of Self Watering is a tool that can clean the air in the room. Although not up to 100%, but the tool is proven to be able to absorb pollutants in the room naturally. This product is an eco-friendly water purifier that uses *Sanseveira* plants and other plants as the main filter in absorbing air pollutants in the room.

## MATERIALS AND METHODS

This research used *One Group Pretest Post-test Design*, to observed a condition before treatment and also transformation that occur after a treatment (Notoatmodjo, 2012:57).

The differences between before and after treatment would be assume as an effect of treatment.

Test I                      Treatment                      Test II  
O1 ----- X ----- O2

**Location and time:** Research was done in Health Laboratorium in Surabaya City, research was done during January to December 2019 based on schedule attached.

**Object and Samples:** Object in this research was the number of mold that is taken from indoor room. Samples that were used in this research was moldy wall. There were 3 variations and 9 replications, therefore we used 27 samples in every 1 group before and after treatment.

## RESEARCH VARIABLES

- Dependent variable was the number of mold from indoor room samples.
- Independent variables were water vapor produced by Humidifier using *Sanseveira* solution at 50%, 70%, and 100% concentration.

## RESEARCH MATERIALS

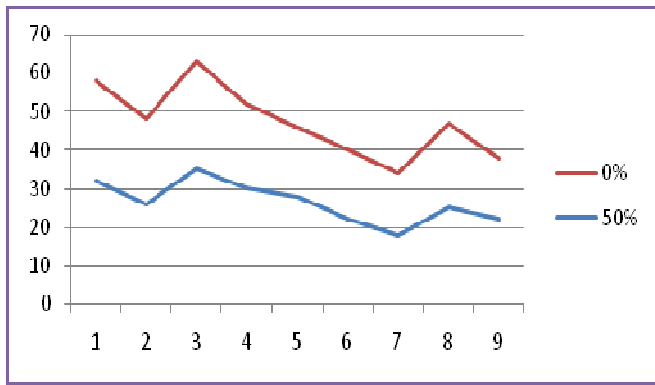
Materials in this research were *Sanseveira* extract, plate count agar, saboraaud dextrose agar, SIM (sulfur, indol, motility) agar, nutrient broth, sugar (glucose, lactose, sucrose, maltose, mannitol) simon citrate, triple sugar iron agar, gentian violet, lugol, alcohol 70%, aquades, and lactophenol cotton blue.

## RESULTS AND DISCUSSION

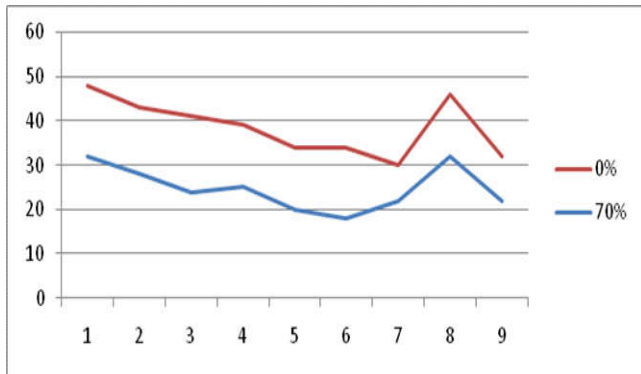
**The Results of Mold Number from Indoor Room Before and After Using Humidifier Modification by Adding *Sanseveira* Extract Solution:** Mold measurement in indoor room before and after using humidifier modified by *Sanseveira* extract variations range 50%, 70%, and 100% for 4 hours give results as below:

**The Results of Mold Number from Indoor Room Before and After Using Humidifier Modification by Adding 50% of *Sanseveira* Extract Solution:** The results of indoor room mold number before treatment by *sanseveira* solution using humidifier was 18 CFU/m<sup>3</sup> and its maximum level was 35 CFU/m<sup>3</sup>, the average results of indoor room mold number was 30,59 CFU/m<sup>3</sup>. After treatment by 50% *sanseveira* solution using humidifier, the minimal indoor room mold number was 16 CFU/m<sup>3</sup> with its maximum level was 28 CFU/m<sup>3</sup> and its average level was 24,62 CFU/m<sup>3</sup>. Both of the results (before and after treatment using 50% of *Sanseveira* solution) still exceeded the threshold regulation that is 0 CFU/m<sup>3</sup> based on Permenkes 1077/MENKES/PER/V/2011. The averages differences of indoor room mold number using 0% and 50% of *Sanseveira* extract can be seen in graphic below.

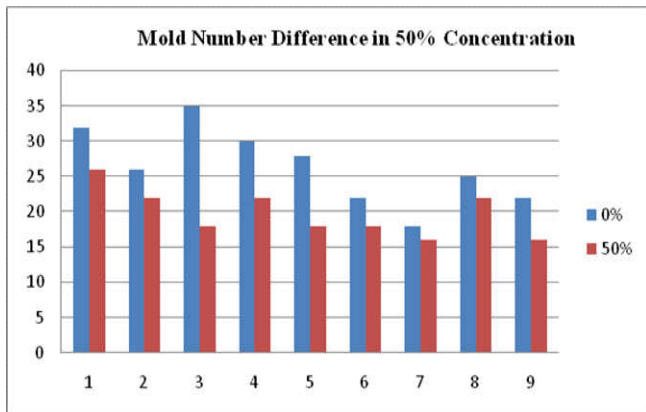
**The Results of Mold Number from Indoor Room Before and After Using Humidifier Modification by Adding 70% of *Sanseveira* Extract Solution:** The results of indoor room mold number before using Humidifier Modification that is added by 70% of *Sanseveira* solution was 18 CFU/m<sup>3</sup> (minimum value) and its maximum value was 32 CFU/m<sup>3</sup>. The minimum value of mold number after treatment using 70% of *Sanseveira* extract was 8 CFU/m<sup>3</sup> and its maximum value was 17 CFU/m<sup>3</sup>. Both of the results (before and after treatment using 70% of *Sanseveira* solution) still exceeded the threshold regulation that is 0 CFU/m<sup>3</sup> based on Permenkes 1077/MENKES/PER/V/2011.



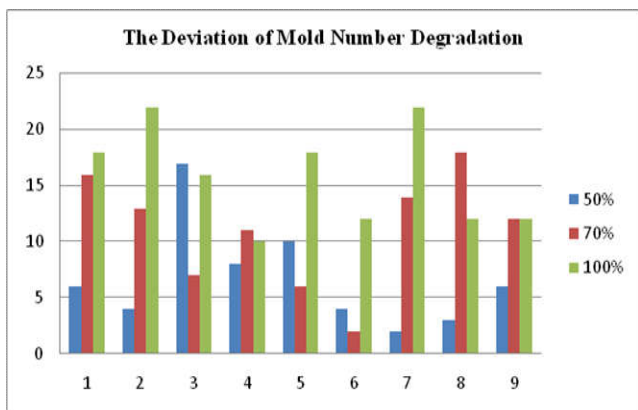
Graphic 1. The Difference of Mold Number before and after treatment by 50% Sanseveira extract.



Graphic 2. The Difference of Mold Number before and after treatment by 50% Sanseveira extract



Graphic 3. The Difference of Indoor Room Mold Number Before And After 50% of Sanseveira Extract Solution Added



Graphic 3. Indoor Room Mold Number Degradation after Treatment by Adding Various Sanseveira Extract to Humidifier

The averages differences of indoor room mold number using 0% and 70% of Sanseveira extract can be seen in graphic below.

**The Results of Mold Number from Indoor**

**or Room Before and After Using Humidifier Modification by Adding 70% of Sanseveira Extract Solution:** The results of indoor room mold number before using Humidifier Modification that is added by 100% of Sanseveira solution was 10 CFU/m<sup>3</sup>(minimum value) and its maximum value was 22 CFU/m<sup>3</sup>. while the minimum value of mold number after treatment was 0 CFU/m<sup>3</sup> (minimum and maximum value give the same results). The results after room treatment using 100% of Sanseveira extract which added to humidifier showed that it fulfill the regulation permenkes 1077/MENKES/PER/V/2011.

**The Analysis of Indoor Room Mold Number Degradation Using Humidifier Modification That Is Adding by Sanseveira Solution:** Based on graphic above, the highest deviation between indoor room mold number pre (before) and post (after) using 50% of Sanseveira solution was 17 CFU/m<sup>3</sup> or 48.57% in third replication. While lowest deviation was 2 CFU/m<sup>3</sup> or 11,11% in seventh replication. The average deviation before and after treatment using 50% of Sanseveira extract as solutions to added to the humidifier was 6,67% CFU/m<sup>3</sup>. The graphic also showed that the degradation of mold number occur in first and second replication, the increment occur in second and third replication, and then it decrease again in fifth to eighth replication, at ninth replication the mold number level increase again. The highest degradation of mold number was happened in third replication that is 48,57%, while lowest degradation occur in seventh replication that is 11,11%. The unstable degradation of mold number occur due to the difference reaction of Sanseveira extract activity that was added to the humidifier. Paired t test results showed there was a significant value of indoor room mold number with p=0,015 < α (0,05). These mean that adding 50% Sanseveira solution to humidifier can decrease mold number in the air significantly.

**The Degradation of Mold Number of Indoor Room Using 50%, 70%, and 100% of Sanseveira Extract as Humidifier Modification Solution:** Research results showed that Sanseveira extract can decrease indoor room mold number due to its saponin, steroid, and triterpenoid which can inhibit fungal growth, the higher the Sanseveira concentration, the more degradation of mold number in room air. These result match with Komala (2012) research saying that the higher concentration of Sanseveira extract the more it can inhibit Candida albicans growth.

**Effectiveness Analysis of Various Sanseveira Extract Concentration and The Mold Number Degradation:** Some statistic test were used to understand various Sanseveira concentration Effectiveness to decrease indoor room mold number. First test was normality test to understand data distribution from this research. There were 54 samples used in this research. Normality test using one way anova test showed p = 0,002 < α (0,05). These mean that various Sanseveira concentration (50%, 70%, and 100% has the same potential and Effectiveness to decrease indoor room mold number. There was a significant difference in 50% concentration. It is mean this concentration was the most optimum and effective concentration to decrease mold number in air room.

## Conclusion

- There was a significant different of indoor room mold number before and after treatment using humidifier modification by adding *Sansevieria* extract solution, it is as results from Post Hoc Test.
- Indoor mold number occur after adding *Sansevieria* extract solution to humidifier. The degradation deviation in 50% of *Sansevieria* concentration was 12,22 CFU/m<sup>3</sup>, in 70% concentration was 18,77 CFU/m<sup>3</sup> and in 100% concentration was 26,88 CFU/m<sup>3</sup>.
- The most effective concentration to decrease mold number in indoor room was 100%, it also match with the result of anova test.

## Recommendation

further research is needed regarding the use of active ingredients and different concentrations in making room air healthy

## REFERENCES

- Afifah T, 2009. Air Pollution. Bandung: Institusi Teknologi Bandung
- Apsari, 2017. Air Purifier Design with Eco-friendly Concept and Self Watering Fitur. Undergraduate thesis, Institut Teknologi Sepuluh Nopember
- Arifah Rahayu ,Rapih, Nur Rochman, Pertumbuhan Setek *Sansevieria cylindrica* 'Skyline' Cuttings Growth in Various Plants Size, Material, and Growing Media Composition, Jurnal Agronida ISSN 2442-2541 Volume 2 Number 1, April 2016
- Asnawi R. 2015. Climate Change and Food Sovereignty in Indonesia. Production Review and Poverty. *Sosio Informa* 1 (3) : 293 – 309
- Bornehag C.G., Blomquist G., Gyntelberg F., Jarvholm B., Malmberg P., Nordvall L., Nielsen A., Pershagen A., Pershagen G., Sundell J. (2001). *Dampness in Building and Health*. Indoor Air Journal 2001; 11; 72-86. Denmark.
- Brooks, G.F., Butel, J.S., Morse, S.A. 2005. Medical Microbiology. Terjemahan tim FKUI. Salemba Medika Utama. Jakarta
- Corie Indria Prasasti, J. Mukono., Sudarmaji, Air Quality Effect in Air Conditioner ed Room to Health Problem, Environmental Health Journal Vol.1, no.2, January 2005 ; 11: 162
- Distan,Riau."Aesthetic Plant, *Sansevieria*."(Accessed from [http://distan.riau.go.id/index.php/component/content/article/52-tanaman-hias/193-lidah\\_mertua\\_tanggal\\_3th\\_April\\_2012\\_at\\_16.50\\_WIB](http://distan.riau.go.id/index.php/component/content/article/52-tanaman-hias/193-lidah_mertua_tanggal_3th_April_2012_at_16.50_WIB))
- Elsberry, RB. 2007 *Indoor Air Pollution Can Sicken Office Workers*. Electrical Apparatus. August.18:34-44.
- Febria Whika Dewatisari, Leni Rumiyantri , dan Ismi Rakhmawati, *Rendemen and Phytochemical Screening using Leaf extract of Sansevieria Sp*, Jurnal Penelitian Pertanian Terapan Vol. 17 (3): 197-202 ISSN 1410-5020
- Gandjar, I. 2006. Basic and Applied Micology. Jakarta: Yayasan Obor Indonesia.
- Handayani, DN. 2016. Fungal Contamination in Microbiology Laboratorium Borneo Lestari Banjarsari Health Analysis Academy. Juni 2016. Tidak diterbitkan (Karya Tulis Ilmiah) Akademi Analisis Kesehatan Borneo Lestari.
- Irianto, A. 2002. Environmental Microbiology. First Edition. Pusat Penerbitan Universitas Terbuka: Jakarta. Page 72.
- Izzah, N. 2015. Air Quality in Waiting Room and Non-Medical Treatment of Ciputat Community Health Center in South Tangerang Using Fungal Parameter. Sains and Technology Faculty Universitas Islam Negeri SyarifHidayatullah: Jakarta. Page 15.
- Kanimochi,M, 2011, *Investigating the physical characteristic of Sansevieria trifasciata fibre*, International Journal of Scientific and Research Publication, Vol.1, Issue 1, Desember 2011, ISSN 2250-3153
- Komala, Oom., Bina L.S., Nina S. 2012. Effectivity Test of *Sansevieria* Ethanol Extraxt to *Candida Albicans*. Fitofarmaka, Vol. 2, No.2, Desember 2012 : 146-152
- Kompas.com with title "The Bacground of DKI Jakarta Government using *Sansevieria* as Pollution Solution", <https://megapolitan.kompas.com/read/2019/07/24/07444551/di-balik-keputusan-pemprov-dki-pakai-lidah-mertua-sebagai-solusi-polusi?page=all>. Writer: Nursita Sari, Editor : Jessi Carina)
- Laila Fitria, dkk., 2008. X University Library Biological, Physiscal, and Chemical Air Quality, inside Makara Kesehatan Vol. 12, No.2, Desember 2008, Page77-83.
- Lingga, P. 2005. Farming Without Soil, Hidroponik (Hidroponik Bercocok Tanam Tanpa Tanah). Penebar Swadaya. Jakarta. 80 Hal.
- Lombogia Brily, Fona Budiarmo, Widi Boddi, 2016, Inhibit Test of *Sansevieria* Extract to The Growth of E.coli and Streptococcus sp (Uji daya hambat ekstrak daun lidah mertua (*Sansevieria trifasciata folium*) terhadap pertumbuhan bakteri *Escherichia coli* dan Streptococcus sp), Jurnal e-Biomedik (eBm), Volume 4, Number 1, January-June 2016
- Mahardika, R. A. D. 2014. *Sansevieria* Antioxidant Extraction Using Microwave Assisted Extraction and Pulsed Elevtric Field (Ekstraksi Antioksidan dari Lidah Mertua (*Sansevieria trifasciata Prain*) Menggunakan Metode Microwave Assisted Extraction dan Pulsed Electric Field). Skripsi. Fakultas Teknologi Pertanian. Universitas Brawijaya. Malang
- Maier, R. M., Pepper, I.L & Gerba, C. P. 2005. *Environmental Microbiology a Laboratory Manual*. Edisi Kedua. Elsevier Academic Press: USA. Pages 67-68.
- Muhammadah, S. A., U. Nurullita, Mifbakhuddin. 2011. The Effect of *Sansevieria* Plant Age and Density to the Air Carbon Monocside Level (Pengaruh Umur dan Kerapatan Tanaman Lidah Mertua (*Sansevieria*) Terhadap Kadar Karbonmonoksida (CO) di Udara). Skripsi. Fakultas Kesehatan Masyarakat. Universitas Muhammadiyah. Semarang.
- Nababan K M, 2014,. Pulp Making from *Sansevieria* Using Soda Method (Pembuatan Pulp dari Bahan Baku Serat Lidah Mertua (*Sansevieria*) dengan Menggunakan Metode Soda), Politeknik Negeri Sriwijaya, hal. 4 – 9.
- National Health and Medical Research Council (NHMRC). 2009. *Guideline for the Non-Surgical Management of Hip and Knee Osteoarthritis*. Asutralia : The Royal Australian College of General Practitioners. Australia : Royal Australian College of General Practitioners. Page: 23-55.
- Notoatmodjo,S. 2012. Health Research Methodology (Metodologi Penelitian Kesehatan). Jakarta: Rineka Cipta.
- Oktora Bunga. The Relation of Physical Air Quality with Sick Building Syndrome (*Hubungan Kualitas Fisik udara dengan sick building syndrome*). Skripsi. Depok : Fakultas Kesehatan Masyarakat Universitas Indonesia , 2008.
- Pollard, S.J.T.,Edwards, R.A., Fleet, G.H., Wootton, M. 2006. *Bioaerosol releases from compost facilities: evaluating*

- passive and active source terms at green waste facility for improved risk assesment. *Atmospheric Environment*. 40: 1159-1169.
- Philip, D., P. K. Kaleena, K. Valivittan, C. P. G. Kumar. 2011. *Phytochemical Screening and Antimicrobial Activity of Sansevieria roxburghiana Schult. and Schult. F. Journal of Scientific Research*, 10(4): 512-518.
- Prabowo, A.Y, T. Estiasih, I. Purwatiningrum. 2014. *Dioscorea esculenta L. Bulbs as Food Source Contain Bioactive Compound (Umbi Gembili (Dioscorea esculenta L.) sebagai Bahan Pangan Mengandung Senyawa Bioaktif)*. *Jurnal Pangan dan Agroindustri*. 2(3):129-135
- Putranti, Ristyana Ika. 2013. *Phytochemical Screening and Antioxidant Activity of Seaweed Extract Sargassum duplicatum dan Turbinaria ornata* from Jepara (Skrining Fitokimia dan Aktivitas Antioksidan Ekstrak Rumput Laut *Sargassum duplicatum dan Turbinaria ornata* dari Jepara). Tesis. Universitas Diponegoro. Semarang
- Purwanto AW. 2006. *Sanseveira, Beautiful Plant That Absorbed Toxin (Sansevieria Flora Cantik Penyerap Racun)*. Yogyakarta: Kanisius.
- Purwanto. 2011. *Statistic For Research (Statistika Untuk Penelitian)*. Penerbit: Pustaka Pelajar. Yogyakarta
- Rahimah, R. 2015. *Simplisia Characteristic and Phytochemical Screening and Antioxidant Activity test of Sanseveira Ethanol Extract (Karakteristik Simplisia dan Skrining Fitokimia serta Uji Aktivitas Antioksidan dan Ekstrak Etanol Daun Lidah Mertua (Sansevieria trifasciata var. laurentii))*. Universitas Sumatera Utara. Medan
- Rahmania Tiara Yunisa1\* , Natalia Sari Susanto1 , Teti Estiasih1 , Nur Ida Panca1, *Snake Plant's (Sansevieria trifasciata) Potency as A Metal Biosorbent*, *Jurnal Pangan dan Agroindustri* Vol.5 No.4:66-70, Oktober 2017
- Rémy Bertrand Teponno, Chiaki Tanaka, Bai Jie, Léon Azefack Tapondjou, Tomofumi Miyamoto, *Trifasciatosides A–J, Steroidal Saponins from Sansevieria trifasciata*, *Chemical and Pharmaceutical* , On line ISSN1347-5223, Print ISSN : 0009-2363, ISSN-L: 00092363
- Riwidikdo, H. 2013. *Health Statistic and SPSS Application on Research Prosedure (Statistik Kesehatan dan Aplikasi SPPS Dalam Prosedur Penelitian)*. Yogyakarta: Rohima Press
- Rokhmalia, F.2016. *Peningkatan Enzim SOD Serum dan Keluhan Kesehatan Terhadap Paparan Asap pembakaran Kayu Pada Pekerja*. *Suara Forikes*, Vol:VII No.2, April 2016.
- Rosha, P. T., Fitriyana, M. N., Ulfa, S. F., & Dharminto. (2013). *Sanseveira Utilization to Reduce Air Pollution in Semarang City (Pemanfaatan Sansevieria Tanaman Hias Penyerap Polutan Sebagai Upaya Mengurangi Pencemaran Udara Di Kota Semarang)*. *Jurnal Ilmiah Mahasiswa*, 3(1), 1–6.
- Sakakibara H1, Honda Y, Nakagawa S, Ashida H, K. K. (n.d.). *Simultaneous determination of all polyphenols in vegetables, fruits, and teas. J Agric Food Chem. Sanseveira*, 200 Spectacular Variant (*Sansevieriae*, 200 Jenis Spektakuler). Jakarta: Niaga Swadaya, 2008; p. 2-18
- Setyanto, R BG Pugu (2010) *Air Pollution Measurements Design Using Microcontroller AT89S51 and TGS 2600 sensor (Rancang Bangun Alat Pengukur Tingkat Polusi Udara Berbasis Mikrokontroler AT89S51 menggunakan sensor TGS 2600)*. Undergraduate thesis, Department of Physics, Diponegoro University.
- Spengler, J., Samet, J.M., & McCarthy, J.F. (2001). *Indoor Air Quality* New York: McGraw-Hill
- States, U. *Sick building Syndrome. EPA*. dalam <https://doi.org/10.1136/oem.2003.008813>
- Tahir, M.I. dan M. Sitanggang. 2010. *Sansevieria Ekklusif*. Yogyakarta : Agromedia Pustaka.
- T.P. Tim Cushnie, A. J. L. 2005. *Antimicrobial activity of flavonoids. International Journal of Antimicrobial Agents* (Vol. 3). <https://doi.org/10.1016/j.ijantimicag.2005.09.002>
- Tumbuhan Penyerap Pollutan – Integrated Marketing Communications. (n.d.).
- U.S. EPA. 2005. *Emission Factors & Ap-42, Technology Transfer Network Clearing House For Inventories & Emissions Factors*
- Waluyo, L. 2005. *Environmental Microbiology (Mikrobiologi Lingkungan)*. Penerbit Universitas Muhammadiyah Malang: Malang.
- WHO. (2003). *Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide*. Report on WHO Working Group: Bonn
- WHO Region Office for Europe. *Burden of Disease from Indoor Air Pollution*. Denmark, 2012

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