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THE CONTENT OF VARIOUS DOMESTIC MICROBES AND THEIR CORRELATION TO INHALANT ALLERGEN IN HOUSE DUST BETWEEN URBAN AND RURAL RESIDENTS IN MALANG RAYA INDONESIA

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Graphical abstract

Abstract

This research aimed at: describing the content of various domestic microbes in house dust of urban and rural residents, covering the amount of fungi, *E.coli*, *Salmonella*, and *Shigella*; and analyzing the correlation between the content of domestic microbes and inhalant allergen level in house dust of urban and rural residents. The results concluded these followings: First, house dust in rural and urban areas was identified to contain domestic microbes. Second, house dust in both urban and rural areas was identified to contain inhalant allergen. Third, there was a correlation between the content of domestic microbes and the level of inhalant allergen in house dust of urban and rural residents. However, not all types of domestic microbes had predictive correlation to the level of inhalant allergen. In the urban areas, the one with predictive correlation was *Salmonella*; while in the rural areas, it was *E.coli*.

Keywords: Microbe, Der-p, inhalant allergen

1.0 INTRODUCTION

Dust particles could pile up in various rooms of a house so as to be the habitat of small organisms. Those dust particles could gather on the floor, under the carpet, bed, furniture, curtains, and many others. Dust generally contains organic and anorganic materials that remain staying in the house, and thus becomes the habitat of microscopic organisms to name: *insecta*, *Arthropada* and microbe [1].

One of the important *Arthropoda* in house dusts is dust mite, that is: *Dermatophagoides pteronyssinus* (Der-p). In addition to the notion that Der-p mite in house dust could increase the level of inhalant allergen [1, 2, 3], it is also reported that Der-p mite is the main source of inhalant allergen that initiates allergic reaction of most patients [5]. Inhaling dust containing inhalant allergen, someoAne could suffer from allergic respiratory problem (atophy). Epidemiologic research has proven that 70-80 percents of atophic respiratory diseases are caused by house dust [6]. However, it is not the dust that leads to those diseases, but Der-p mite that lives and grows inside the dust.

Ecologically, the population of Der-p mite undergoes symbiosis with various biotic lives in house dust, including with several domestic microbes related to organic-anorganic materials, namely fungi, *E.coli*, *Salmonella*, and *Shigella*. Accordingly, it has been predicted that allergent inhalan in house dust significantly correlates with the population of domestic microbes. The existence of domestic microbes is as a result of residents' domestic activities at their houses [8]. The activities include: eating habit, playing habit, cleaning up the house leading to the volume of garbage, food residue, and others. Having pets, flowers, and the use of carpets in the house

contribute to add up the amount of organic-anorganic materials. The abundance of organic-anorganic materials in house dust triggers various microorganisms and domestic microbes to use the house dust as their habitat.

There are differences on domestic activities between urban and rural residents, thus the characteristics of their house dust also differ. Consequently, it is crucial to identify various domestic microbes and inhalant allergen level in house dust of urban and rural residents, as well as the correlation between domestic microbe content and inhalant allergen level of house dust in urban and rural areas.

2.0 LITERATURE REVIEW

Dust particles in every house are unavoidable. House dust particles normally have microscopic size. One particle of house dust is around 6 x 10^{-7} mm to 1 mm in diameter [9]. As a result, with one simple movement (e.g. wind blow, brooming, etc), house dust could easily spread and fly on the air inside the house. In its nature, dust particles could freely get into respiratory tract and lung along with the breathing activities [8,9].

House dust contains various organic-anorganic materials so as to be the food source of various organisms including Der-p mite. Those various organic-anorganic materials derive from the residue of human and animal activities, namely: skin peel, cotton fiber, clothing fiber, dust, food residue, etc [9]. The more dust accumulated in a house, the more possibility for Der-p mite to live and grow, producing inhalant allergen. In other words, house dust level positively correlates with inhalant allergen level.

Inhalant allergen is a kind of glico-protein with antigenic characteristic that human body should fight against. It should be expelled or fought by immune system. Not all body parts of Der-p mite are allergen. By anatomy, the part of mite that contains allergen is in its digestion tract (gut). The gut of mite that is allergen is midgut posterior and hindgut anterior [2,10]. The feces produced by mite's digestion system contain inhalant allergen. Mite's feces could mix up with house dust, altering house dust into allergenic. By logic, house dust that does not contain Der-p mite's feces is non-allergenic.

Urban residents are more highly aware of Der-p mite inhalant allergen than rural residents [11]. Some studies show that by percentage, residents living in the areas with more exposure to allergen of Der-p have more awareness compared to those living in lower allergen areas. Regional variations on mite' allergen level mostly depend on the differences in relative humidity, temperatures, life styles, and housing conditions [12]. The average of daily humidity along the year is higher in urban areas compared to that of in rural areas in Indonesia [13].

3.0 METHODOLOGY

This research was conducted by means of descriptive-analytic design. Descriptive research aimed at measuring domestic microbe level: fungi, *E.coli*, *Salmonella*, and *Shigella*, as well as investigating inhalant allergen level in house dust of urban and rural residents. Analytic research aimed at analyzing the correlation between domestic microbes and inhalant allergen level of house dust in urban and rural areas.

3.1 Population and Sampling Technique

The population of this current research was residents in Malang Raya, divided into two clusters: Malang Municipality and Malang Regency. The first stage was determining the clusters of urban and rural areas based upon area category, namely: urban area is Malang Municipality and rural area is Malang Regency. The second stage was determining by random five Districts in each area, and there were by random five houses to choose in each District.

3.2 Data Collecting Technique

The data were collected by employing field and laboratory observations. Field observation was to take dust sample from every house. Laboratory observation was to measure and identify the content of domestic microbes (the total of fungi, *E.coli*, *Salmonella*, and *Shigella*) and the inhalant allergen level in each sample of house dust.

3.3 Analysis Technique

The data were analyzed by means of descriptive and inferential statistics. The descriptive statistics was to display the data in the form bar chart and the average of each variable. Regression analysis used was multiple linear regression analysis. This analysis was utilized to investigate the correlation and causality between the content of domestic microbes and inhalant allergen level of house dust.

4.0 RESULTS AND DISCUSSION

House dust materials in rural areas were collected from 25 houses in five Districs, namely: Dau, Singosari, Tumpang, Bululawang, and Pagelaran. Each District was represented by 5 houses. Similarly, house dust materials in urban areas were collected from 25 houses in five Districts, namely: Sukun, Lowokwaru, Blimbing, Gadang, and Sawojajar. The house dust was then observed in the laboratory, and the results are presented in Figure 1 and Figure 2.

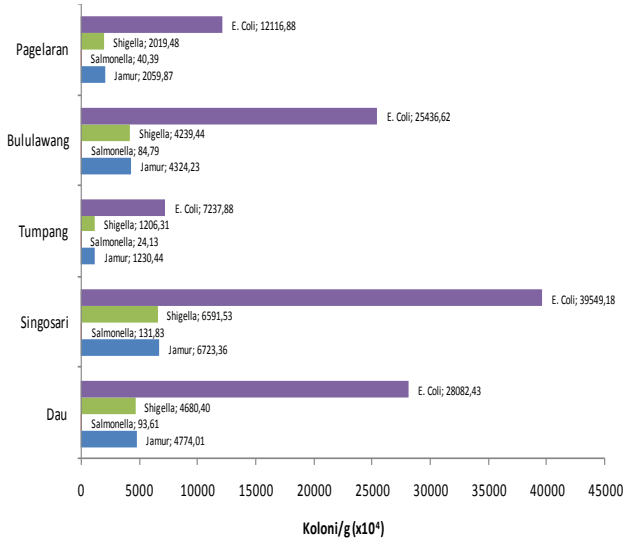

Figure 1 The comparison of amount (colony/gram) of domestic microbes in house dust of rural areas

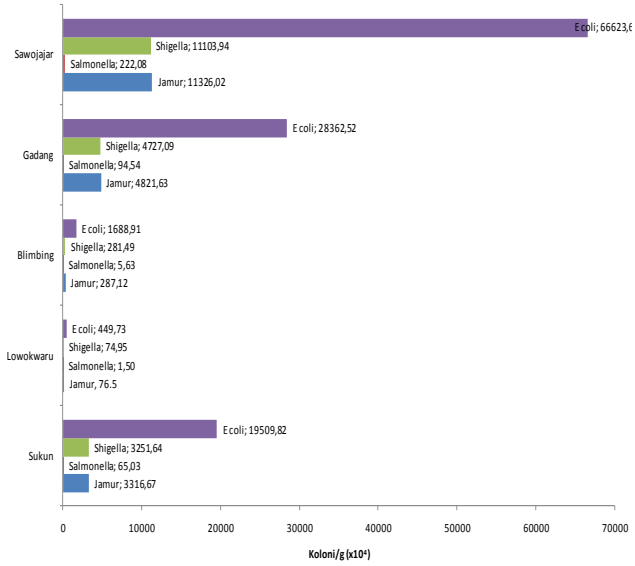

Figure 2 The comparison of amount (colony/gram) of domestic microbes in house dust of urban areas

House dust in rural areas was identified to contain domestic microbes (fungi, *Salmonella*, *Shigella*, and *E.coli*). The highest amount of microbes in rural house dust was for *E.coli*, reaching 39546.18 x 10^4 colony/ 1 gram dust (colony/gram) in Singosari District; while the lowest amount was for *Salmonella* accounting for 24.13 x 10^4 colony/gram in Tumpang District.

Similar to that of in rural areas, house dust in urban areas was identified to also contain domestic microbes. The highest amount of microbes in urban house dust was for *E.coli*; while the lowest one was for *Salmonella*. The highest amount of *E.coli* was reaching 66623.62 x 10^4 colony/gram in Sawojajar District; and the lowest amount of *Salmonella* was 1.50 x 10^4 colony/gram in Lowokwaru District.

The average of domestic microbe colony in rural areas was lower than that of in urban areas. Comparing the amount of domestic microbes based upon urban and rural areas, the average of domestic microbe colony per gram house dust was lower in rural areas than in urban areas.

There were differences in the level of domestic microbes of house dust between rural and urban areas (Figure 3). Fungi microbe in rural areas was accounted for 2202.14 x 10^4 colony/gram, lower than that of in urban areas that was 4582.20 x 10^4 colony/gram. *Salmonella* microbe in rural areas was accounted for 43.18 x 10^4 colony/g, lower than that of in urban areas that was 77.76 x 10^4 colony/gram. *Shigella* microbe in rural areas was accounted for 3747.43 x 10^4 colony/gram, lower than that of in urban areas that was 3887.82 x 10^4 colony/gram. *E.coli* microbe in rural areas was accounted for 12953.78 x 10^4 colony/gram, lower than that of in urban areas that was 26954.13 x 10^4 colony/gram. Accordingly, rural areas had lower fungi, *Salmonella*, *Shigella*, and *E.coli* microbes that that of in urban areas.

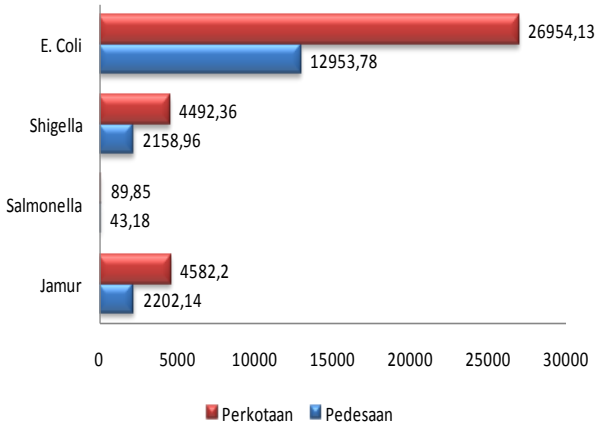

Figure 3 The comparison of various microbes (colony/gram x 10^4) in house dust between urban and rural areas

House dust materials in urban and rural areas were also identified to contain inhalant allergen. There were differences of inhalant allergen level in house dust between urban and rural areas. Based upon Figure 4, the average of allergen level of urban house dust was 0.88 mg/gram, higher than that of in rural house dust that was 0.36 mg/gram. The highest level of inhalant allergen for urban areas was in Sawojajar District reaching 1.021 mg/gram; while the lowest one was 0.660 mg/gram in Sukun District. The highest level of inhalant allergen for rural areas was in Dau District reaching 0.465 mg/gram; while the lowest one was 0.215 mg/gram in Pagelaran District.

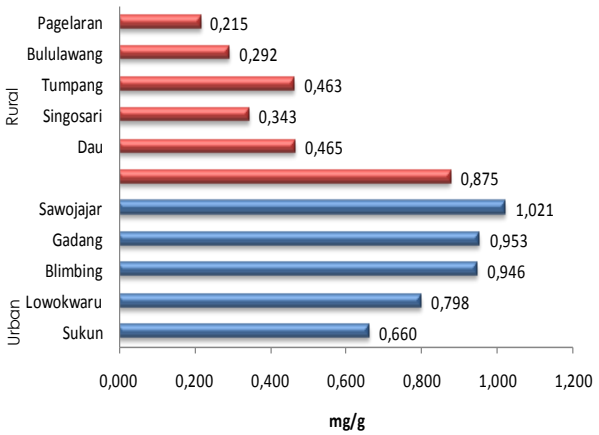

Figure 4 The comparison of inhalant allergen level in house dust between urban and rural areas.

The next stage was conducting linear correlation analysis on the data between domestic microbe colony and allergen level of house dust in rural and urban areas. The correlation analysis was to investigate the correlation between every domestic microbe and allergen level of house dust. The results of the analysis are presented in Table 1. The analysis on rural areas showed that there was a positive correlation between domestic microbes and the level of allergen in house dust. The higher the amount of microbe bacteria in rural house dust, the higher the allergen level was.

Table 1 The Results of Correlation Test between Domestic Microbe Content and Allergen Level of Rural House Dust

Domestic Microbe	Sig.	Pearson Correlation Coefficient
Fungi	0.000	0.709
Salmonella	0.000	0.709
Shigella	0.000	0.708
E.Coli	0.000	0.709

The result of correlation analysis for urban areas is presented in Table 2. Similar to that of in rural areas, the analysis on urban areas showed that there was a positive correlation between domestic microbes and the level of allergen in house dust. The higher the amount of microbe bacteria in urban house dust, the higher the allergen level was.

Table 2 The Results of Correlation Test between Domestic Microbe Content and Allergen Level of Urban House Dust

Mikrob	Sig.	Pearson Correlation Coefficient
Fungi	0.000	0.579
Salmonella	0.000	0.580
Shigella	0.000	0.579
E Coli	0.000	0.579

After showing the significant correlation, the next stage was determining the causality correlation by means of multiple linear regression analysis. This analysis was utilized for the data of domestic microbe content as predictors; while the data of inhalant allergen of house dust were as data criteria. The result of this sort of analysis on rural areas showed that not all types of domestic microbe had causality correlation with inhalant allergen level of house dust. The type of domestic bacterium that had causality correlation was *E.coli*. It means that although every domestic microbe correlated with allergen level, only *E.coli* that significantly influenced inhalant allergen level of rural house dust, accounting for 50.3%. The causality correlation between *E.coli* bacterium (Y) and inhalant allergen level (X) of rural house dust could be represented by this regression line Y = 0.314 + 1.90 x 10^{-10} (X). Based upon that regression line, *E.coli* bacterium influenced for about 50.3% towards inhalant allergen level of house dust in rural areas.

The multiple linear regression analysis on urban areas showed similar result to that of in rural areas that not all types of domestic microbe had causality correlation with inhalant allergen level of house dust. The type of domestic bacterium that had causality correlation was *Salmonella*. It means that although every domestic microbe correlated with allergen level, only *Salmonella* that significantly influenced inhalant allergen level of urban house dust, accounting for 33.6%. The causality correlation between *Salmonella* bacterium (Y) and inhalant allergen level (X) of urban house dust could be represented by this regression line Y = 0.836 + 5.073 x 10^{-8} (X). Based upon that regression line, *Salmonella* bacterium influenced for about 33.6% towards inhalant allergen level of house dust in urban areas.

The results of regression analysis led to the notion that there were differences in internal environment characteristics between rural and urban areas in the context of house dust inhalant allergen. It could be analyzed from the types of bacteria that affect dust inhalant allergen. *E.coli* domination in house dust other than other domestic bacteria was the indication that house dust in rural areas had been polluted by human feces. This was in accordance with the statement that the existence of *E.coli* bacterium in the sample indicated that the sample had been polluted by human feces [14].

Based upon domestic bacteria indicator, the characteristics between urban and rural areas differed. The dominance of *Salmonella* bacterium in urban house dust indicated that it had formerly been polluted by various food or products with ingredients from animal breeding. This was in line with the statement that some diseases caused by *Salmonella* bacterium in house related to food made from animals and pets inside the house [15].

5.0 CONCLUSION

The results of this current research concluded these followings: First, house dust in rural and urban areas was identified to contain domestic microbes: fungi, *E.coli*, *Salmonella*, and *Shigella*. The highest amount of microbes in rural house dust was for *E.coli*, reaching 39546.18 x 10^4 colony/ 1 gram dust (colony/gram) in Singosari District; while the lowest amount was for *Salmonella* accounting for 24.13 x 10^4 colony/gram in Tumpang District. The highest amount of microbes in urban house dust was for *E.coli*; while the lowest one was for *Salmonella*. The highest amount of *E.coli* was reaching 66623.62 x 10^4 colony/gram in Sawojajar District; and the lowest amount of *Salmonella* was 1.50 x 10^4 colony/gram in Lowokwaru District.

Second, house dust in both urban and rural areas was identified to contain inhalant allergen. The highest level of inhalant allergen for urban areas was in Sawojajar District reaching 1.021 mg/gram; while the lowest one was 0.660 mg/gram in Sukun District. The highest level of inhalant allergen for rural areas was in Dau District reaching 0.465 mg/gram; while the lowest one was 0.215 mg/gram in Pagelaran District.

Third, there was a correlation between the content of domestic microbes and the level of inhalant allergen in house dust of urban and rural residents. However, not all types of domestic microbes had predictive correlation to the level of inhalant allergen. In the urban areas, the one with predictive correlation was *Salmonella*; while in the rural areas, it was *E.coli*.

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References

[1] Rofieq, A. 2001. *Our Dust House*. Edition II. Malang: Penerbit IKIP Malang.
[2] Bronswijk, E. M. H. J. 1981. *Houst Dust Biology*. Netherlands: NIB Publishers P.O.Box 144.
[3] Mahdi, D. H. 1995. *Environmental Impact on the Allergic Disease and Human Resources in the Era of development*. Inauguration Speech Professor on Universitas Airlangga, Surabaya.
[4] WHO. 2010. Allergic Rhinitis and its Impact on Asthma (ARIA). *Allergy*. Canada: World Health Organization; 2010.
[5] Baratawidjaja, K. G., Rengganis, I. 2009. *Knowing Allergies.* Jakarta: Penerbit Djambatan.
[6] NursingBegin.com. 2009. *House Dust Cause of Asthma*. (online). Accessed on 12 October 2009.
[7] Rofieq, A. 2010. *Correlation Between the Amount of Dermatophagoides Mite, Dust Weight, Type Fungi, and Amount of Pollen and Conttent of House Dust Allergent in Urban Area (a Preleminary Study)*. Papers Presented on International Biotechnology Seminar & 5th KBI Congress, University of Muhammadiyah Malang, 27–30 July 2010.
[8] Oribe, Y & Miyazaki, Y. 2000. Effect of Relative Hunidity on the Poplation Growth of House-Dust Mites. *Journal Physiological Anthropology*. 19(4): 201-208.
[9] Rofieq, A. 2015. *Management of House Dust, Based Environmental Biology*. Malang: UMMPRESS.
[10] Soerjani, M., Ahmad, R., Munir., R. 2008. *Environment: Natural Resources and Population in Development*. Jakarta: Penerbit University of Indonesia.
[11] Chang, J.W, Lin C.Y, Chen W.L., Chen, C.T. 2006. Higher Incidence of *Dermatophagoides pteronissinus* Allergy in Children of Taipei City than in Children of Rural Areas. *Journal Microbiologi, Immunology, Infection*. 39(1): 1-12.
[12] Rofieq, A. 2005. Influence of Environmental Factors in the House Dust Mite Dermatophagoides on Population and Its Relationship with Skin Sensitivity Test Results in Patients with Allergic Respiratory Tract. *Saintika Medika*. 2 (2): 1-15.
[13] Rofieq, A., Chamisijatin, L., Sukarsono, Waluyo, L. 2006. Development Management Model Based Sources Shelter Allergens House Dust Inhalants in East Java Rural Population. *Reserach Report Hibah Bersaing XI/2 DP3M Dikti Depdiknas*. Malang: University of Muhammadiyah Malang.
[14] Chandra, B. 2009. Community Peventive Medicine. Jakarta: Penerbit EGC.
[15] Behravesh, C. B., *et al.* 2010. Human *Salmonella* Infections Linked to Contaminated Dry Dog and Cat Food, Published online August 9, 2010. *Pediatrics*. 126(3): 477-483. doi: 10.1542/peds.2009-3273.