AN OVERVIEW OF LABORATORY EXAMINATION RESULTS ON FARMER THAT EXPOSED BY PESTICIDES

Azahra Niken Ferina Putri*, Perdina Nursidika, Wikan Mahargyani
Jenderal Achmad Yani Cimahi University
*Corresponding Author: Azahra Niken Ferina Putri.
Email: azahra06niken@gmail.com

ABSTRACT

Introduction*: Pesticides are all chemicals and other substances used to eliminate or prevent pests and diseases that damage crops, crop parts or agricultural products and turn off leaves and prevent unwanted growth. Exposure to pesticides on the human body will affect blood components. The liver is one of the target organs of pesticides. The increase in the enzyme aspartate amino transferase (AST) or serum glutamate oxaloacetate transaminase (SGOT) and alanine amino transferase (ALT), or serum glutamate pyruvate transaminase (SGPT) is an indicator of liver damage. Serum levels of AST and ALT increase when tissue damage occurs. Pesticides such as organophosphate (OP), carbamate, and pyrethroids show inhibitions in the organization and development of leukocytes by inducting apoptosis or cell cycles and disrupting the immunological function of each immune cell.* ***Methodology****: used is Literature Review. Data collection using electronic databases namely Google Schoolar and SINTA. Data analysis is done by discussing and compiling various supporting sources of literature.* ***Research findings****: of Five studies showed there was the abnormalities in the value of biochemistry, hematology, and immunology in farmers who are exposed to pesticides.* ***Conclusion****: Pesticides exposure affected on the laboratory examination results.*

Keywords*: Pesticides, farmers, hemoglobin, hematology, biochemistry, immunology*

1. Introduction

Population growth from year to year causes the need for food to increase. The food crop intervention program is expected to increase food production on land where most of the population is farming, thus making agriculture an important sector for the welfare of the Indonesian population. The high demand for large and high-quality agricultural products (free from pests) quickly causes farmers to compete in using pesticides to prevent plants from being attacked by pests[1].

In some statistical data, pesticide user countries are 45% in the United States, 25% in Western Europe, 12% in Japan, and 18% in other developing countries. Indonesia is one of the countries with high use of pesticides. Based on 2012 data, it is stated that the use of pesticides in Indonesia is around 55.42%, while the use of organophosphate pesticides in Indonesia is around 23.29% [2]

According to a study conducted by Crietea in Indonesia in 2015, the use of pesticides increased from 11,587.2 tons in

1998 to 17,977.2 tons in 2000. This shows that there are farmers who rely on pesticides. The use of pesticides most often occurs in horticultural crops, especially vegetables. Based on national pesticide use data according to the Pesticide Commission under the Ministry of Agriculture, as many as 813 pesticide trade names were registered in 2002, then increased to 1082 trade names (brands) in 2004 and more than 1,500 in 2006. In 2013 there were 1,750 species. pesticides with trademarks, including 350 brands of fungicides, 600 brands of herbicides, and 800 brands of pesticides[3]

According to data from the Banjarnegara District Health Office, Central Java, the latest data on pesticide poisoning in 2014 showed that only 15 out of 217 farmers were not poisoned, 5 were severely poisoned, 120 were moderately poisoned, and 77 were mildly poisoned. There are many reasons for pesticide poisoning, including the hygiene of farmers' bodies and the way they spray pesticides (Cristea, 2016).

Farmers who use pesticides are typically exposed to chemicals at all stages of the process (e.g., storage, mixing, preparation and use). Acute pesticide poisoning is a major cause of morbidity and mortality of agricultural workers[4]. Long-term exposure to pesticides can occur through indirect means, such as eating food and drink contaminated with pesticide residues. It is important for farmers to understand the effects of long-term exposure to pesticides in order to minimize the health hazards associated with them[5].

The use of pesticides is to increase agricultural production and reduce crop damage due to pests, thus encouraging farmers to use pesticides with inappropriate composition, dosage and frequency of spraying which in turn brings new problems, especially the health problems of the farmers themselves. Farmers are at higher risk because workers are directly exposed to pesticide pollution [6]

Farmers who are poisoned by organophosphate will show symptoms according to the severity of exposure. Exposure to pesticides in chronic stages with low levels can cause serious health problems, because they interfere with metabolism, are toxic to nerves, carcinogens, disrupt the reproductive and endocrine systems and immune system dysfunction[7]. Organophosphates, such as chlorphyros are known to modulate the immune system, such as increasing CD26 cells and decreasing CD5 cells. Several other organophosphate groups are known to reduce the concentration of immunoglobulins and complement components [8].

Pesticides can induce oxidative stress thereby altering detoxification mechanisms and inhibiting antioxidant enzymes. Pesticide compounds can also damage cell function, including damaging blood cells. In addition to blood cells, pesticides also interfere with other hematological parameters such as hemoglobin. This is due to the presence of chlorinated hydrocarbon groups that affect blood parameters. The results of the study showed a decrease in the number of red blood cells, platelets, hemoglobin concentration, erythrocyte index, and the percentage of hematocrit[9]

In addition to disturbing the hematological and immunological

parameters, the biochemical parameters of farmers exposed to pesticides also experienced abnormalities. This is because organophosphate and carbamate pesticides interfere with carbohydrate, fat, and protein metabolism through inhibition of the enzyme acetylcholine esterase or directly affect target organs[10].

2. Methods

In this study, the method to be used is a systematic literature review. The literature search strategy is based on problem analysis (PICOST) and keywords and a database of research topics, as shown in Table 1.

Table 1 Problem Analysis of the PICOST Method

No	PICOST method	Problem analysis
1.	Population (P)	Pesticide users
2.	Intervention (I)	There is not any
3.	Comparison (C)	There are comparisons and no comparisons
4.	Output (O)	Overview of the results of hematology, biochemistry, and immunology of farmers exposed to pesticides
5.	Study (S)	Cross sectional
6.	Time (T)	2011 to 2020

The results of the selection of literature review searches conducted by researchers (compilers) through the Google Scholar database using the keyword "Description of laboratory results of farmers exposed to pesticides" found 761 journals, then the journals were selected according to the topic and research objectives, 35 journals were obtained, and journals These were selected and 726 journals were excluded because the manuscripts did not match the topic and title. Based on the literature selection process from several journals that match the keywords of the theme the author proposes, the authors determine 2 national journals and 3 international journals that meet the criteria for review or review.

3. Results

Based on the search results, 5 journals related to research were determined about the description of the laboratory results of farmers exposed to pesticides as shown in Table 2 as follows:

Table 2 Literature Search Results

No	Researcher, Publisher and Year	Research result
1.	Mardiyah, A.-A., Sugihartina, G., Rahmat, M., & Solihat, MF (2019). Journal of Health Research Poltekkes MOH Bandung, 11(1), 236–243.	The results of a study conducted on 30 farmers who sprayed pesticides, there were 6 people who experienced a decrease in hemoglobin levels[11]
2.	Arwin, NM, & Suyud, S. (2016). Public Medicine News, 32(7), 245–250.	The average hemoglobin level of the respondents was 16.65 g/dL with the lowest Hb level being 11 gr/dL and the highest is 20 gr/dL.[12]
3.	Lu, JL (2009). Environmental Health and Preventive Medicine, 14(6), 345–352. https://doi.org/10.1007/s12199-009-0105-x	Based on hematological examinations, full-time farmers had higher mean scores for creatinine, white blood cells, red blood cells, hemoglobin, and hematocrit. Of the full-time and part-time farmers, 20 and 7 people were anemic (low hemoglobin, respectively). Of the 232 blood cholinesterase results, 94 (40%) were abnormal.[13]
4.	Aroonvilairat, S., Kespichayawattana, W., Sornprachum, T., Chaisuriya, P., Siwadune, T., & Ratanabanangkoon,	The average albumin concentration and serum protein levels were lower in orchid farmers. Complete and differential

	K. (2015). International Journal of Environmental Research and Public Health, 12(6), 5846–5861.	blood cell counts were not significantly different between farmers and controls[7]
5.	Ayi-Fanou, L. (2018). Journal of Biology and Life Science, 9(1), 65. https://doi.org/10.5296/jbls.v9i1.12461	Based on the hematological profile the values of WBC, RBC, hemoglobin, hematocrit, MCV and platelets were significantly lower in farmers compared to controls, For MCHC and MCH, there was no significant variation within the groups[9]

4. Discussion

Systematic literature reviewconducted on research with a theme that is in accordance with the description of the laboratory results of farmers exposed to pesticides. Here, the authors present an explanation of the results of the research reviews listed in Table 2 of journals relevant to the author's research.

Hematological Parameters

In the first journal according to research conducted by Mardiyah the results of hematological examinations were carried out on 30 farmers who sprayed pesticides, there were 6 people who experienced a decrease in hemoglobin levels. There are 6 farmers with hemoglobin levels below 13.5 g/dL, for farmers with hemoglobin levels 13.5 g/dL there are 24 people. Based on these results, it can be said that most of the spraying farmers do not suffer from anemia. A total of 6 out of 30 subjects experienced a decrease in hemoglobin levels. A total of two people have a body mass index <18 kg/m2, which means that the person is classified as underweight or thin, while the other 4 subjects have a body mass index within the normal range of 18-25 kg/m2. From the results of this study, The decrease in hemoglobin levels in two people who had a body mass index <18 kg/m2 was possible because they had poor nutrition, while for the other four people it was due to other factors, one of which was pesticides which had the active substances chlorphyrophos and profenofos. There was no significant relationship between the spraying period and hemoglobin levels, from 18 people who sprayed a frequency of 27 times, there were 3 farmers who experienced a decrease in hemoglobin levels, while for a frequency of less than 27 times, farmers who experienced a decrease in hemoglobin levels were also 3 people. The results showed that 15 people who sprayed more than 27 times had normal hemoglobin levels. This is possible because farmers in Cisoka Village spray in the morning. Because the morning is the best time to spray, because the ambient temperature is not too hot compared to the afternoon which can cause more sweat production. So that the spraying time is getting late, it will be easier for pesticide poisoning to occur, especially absorption through the skin.

In the second journal according to research conducted by N.M. Arwin [14] the results of hematology were carried out on 106 farmers who sprayed pesticides, there were 4 people who experienced a decrease in hemoglobin levels. The results of the analysis of blood samples showed that the farmer's average hemoglobin level was 16.65 g/dL. Long hours of work have a greater risk of developing anemia. This study shows that four farmers with a working period of more than 20 years suffer from anemia. However, the results show that

there is no significant relationship between the tenure of the farmer and the incidence of anemia. The pesticide doses used by farmers in Cikajang District are mostly measured based on wishes that are not in accordance with the label/instructions contained on the pesticide packaging. Based on the results of the comparison of the two variables, the number of anemic patients with the use of pesticide doses in accordance with their wishes was more than the anemic patients who followed the label/instructions when measuring the pesticide dose, but the results of statistical tests showed that there was no significant relationship between the pesticide dose and the incidence of anemia. This can be caused by various factors, one of which is that the farmer's body is more immune because it has been in contact with pesticides for a long time. In addition, there is a possibility that the active pesticide used is not as stated on the label. one of them is the farmer's body which has become more immune because it has been in contact with pesticides for a long time. In addition, there is a possibility that the active pesticide used is not as stated on the label. one of them is the farmer's body which has become more immune because it has been in contact with pesticides for a long time. In addition, there is a possibility that the active pesticide used is not as stated on the label.

In the third journal according to research conducted by J.L. Lu [15] Hematological examination revealed that full-time farmers had mean values of white blood cells (7,400/mm3 vs 7,000/mm3), red blood cells (5.2 million/mm3 vs 4.7 million/mm3), hemoglobin (14.8 g /dL vs 14.7 g/dL), hematocrit (42% vs 41%), MCH (31.2 vs 31.1 pg), MCHC (35.1% vs 35.4%), and platelets (278,000/ mm3 vs 263,000/mm3). The MCV was slightly higher for part-time farmers (88.7 fl) than for full-time farmers (88.2 fl). About 20 full-time farmers (mean 14.8 g/dL) and 7 part-time farmers (mean 14.6 g/dL) had low hemoglobin. Approximately 65% and 57.14%, respectively, had microcytic anemia, as evidenced by low MCV and low MCH values. Approximately 15% and 14.29%, respectively, had normocytic anemia, with low hemoglobin but normal MCV and MCH values. Increased hemoglobin, hematocrit.

Complete blood cell count and type count were not significantly different between farmers and controls. The values of WBC, lymphocytes, monocytes, RBC, MCHC, platelets, hemoglobin and hematocrit in female farmers decreased. Meanwhile, the value of neutrophils, eosinophils, basophils, MCV, MCH, hemoglobin and hematocrit in male farmers increased [13]

Hematology parameter such as WBC, RBC, hemoglobin, hematocrit, MCV and platelet values were still in normal condition. But when compared between farmers with control, the results of the farmers' hematology are under the control value. For MCHC and MCH are still in normal conditions, the value is still within the control value range. Pesticides are toxic compounds that can inhibit heme biosynthesis steps. That is why pesticide residues cause a decrease in the number of blood cells and cause anemia by inhibiting hemoglobin biosynthesis and reducing the lifespan of red blood cells.

Biochemical Parameters

In the third journal according to research conducted by Lu [15] that full-time farmers had higher mean creatinine values than part-time farmers (89.6 vs. 86.4 l mol/L). Creatinine is a byproduct of muscle metabolism and is produced in constant amounts in the body. Because it is often used as a marker for kidney function, where its function is used to estimate the glomerular filtration rate of the kidney. Some pesticides impair renal function by producing acute tubular necrosis.

In the fourth journal according to research conducted by [16] of all types of pesticides used by farmers, both organophosphate, carbamate and pyrethroid pesticides, the levels of cholinesterase enzymes in erythrocytes and plasma decreased compared to control values. Then the levels of cholinesterase enzymes in erythrocytes and plasma were tested to determine the strength of enzyme inhibition by pesticides. Moderate enzyme inhibition >25%-35% and strong inhibition >35%. From organophosphate and carbamate pesticides, 3 people (12.5%) and 5 people (20.8%) were found to be in moderate and severe inhibition. While in women 4 people (14.3%) and 5 people (17.9%) were found to have moderate and severe obstacles. For the type of pesticide pietroid enzyme inhibition was found in 1 person (16.7%) in men. While in women found 1 person (16.7%) moderate barriers. For the biochemical analysis of serum, BUN (Blood Urea Sodium) and creatinine which is the main indicator of kidney function did not differ between the two groups. Evaluation of serum enzymes and protein factors showed significant differences in albumin and total protein levels. The average albumin concentration was lower in orchid farmers (4.55 g/dL), resulting in lower total serum protein levels (7.59 g/dL). These values in the control group were 4.70 and 7.80 g/dL. Although there is a significant difference in this parameter, the mean value is still within the reference range. Albumin is an important serum protein and is synthesized by the liver. Serum levels depend on a number of factors such as nutritional status, liver function, hormonal factors and urinary and gastrointestinal losses.

AST and ALT examination increased which is characterized as liver damage. As for the GGT examination, urea and creatinine had no effect or the value was still within the control value range. Pesticides that accumulate in the long term will cause damage to the organs of the body that are the target of these pesticide chemicals such as the liver, kidneys, lungs, and others. The liver is one of the target organs for pesticides. Some of the liver's functions include being the center of protein, fat and carbohydrate metabolism, producing bile, producing heparin (blood anticoagulant), producing plasma proteins, cleaning bilirubin from the blood, detoxifying center for toxic substances in the body, forming red blood cells (erythrocytes) and others. Disorders or damage to the liver can interfere with the liver's important functions in metabolism and detoxification. Aspartate aminotransferase (AST) or serum glutamic oxsaloasetic transaminase (SGOT) and alanine aminotransferase (ALT) or serum glutamic pyruvic transaminase (SGPT) are enzymes whose presence and levels in the

blood are used as markers of impaired liver function[9][7]

These enzymes are normally present in liver cells. The liver damage will cause the liver enzymes to be released into the bloodstream so that their levels in the blood increase and indicate impaired liver function Aspartate aminotransferase (AST) or serum glutamic oxsaloasetic transaminase (SGOT) and alanine aminotransferase (ALT) or serum glutamic pyruvic transaminase (SGPT) are enzymes whose presence and levels in the blood are used as markers of impaired liver function. These enzymes are normally present in liver cells. Damage to the liver will cause the liver enzymes to be released into the bloodstream so that their levels in the blood increase and indicate impaired liver function Aspartate aminotransferase (AST) or serum glutamic oxsaloasetic transaminase (SGOT) and alanine aminotransferase (ALT) or serum glutamic pyruvic transaminase (SGPT) are enzymes whose presence and levels in the blood are used as markers of impaired liver function. These enzymes are normally present in liver cells. Damage to the liver will cause the liver enzymes to be released into the bloodstream so that their levels in the blood increase and indicate impaired liver function [17].

Immunological Parameters

In the fourth journal according to research conducted by [16] The concentration of globulin in serum and levels of IgG, IgA and IgM in farmers did not increase or were still in normal conditions. While the results increased at the concentration of IgE, higher than the control value. Lymphocyte levels decreased in CD19+ and B lymphocytes. Meanwhile, CD3+, CD4+, CD8+ and CD16+ / CD56+ did not differ from the control values. This difference may be due to the different effects of each component in the pesticide mixture so that only certain immunoglobulin subclasses are affected by each pesticide. Lysozyme has the ability to lyse and kill gram-positive bacteria through enzymatic cleavage of peptidoglycan. Measurement of lysozyme activity thus implies a non-specific defense status of the immune system. There was a slight increase in serum lysozyme levels in farmers compared to controls (474, 46 ± 105.67 vs. 444.43 ± 75.43 U/mL). However, the difference is not significant.

5. Conclusions

Based on the results of the literature review on the description of the laboratory results of farmers exposed to pesticides, it shows that there are abnormalities in the biochemical, hematological, and immunological values of farmers exposed to pesticides.

Acknowledgment

We would love to give an honorable mention to Medical Laboratory Technology D3 Departement and FITKes Jenderal Achmad Yani University for the support of this literature review

Reference

[1] S. Suparti, Anies, dan O. Setiani, “Beberapa Faktor Risiko yang Berpengaruh terhadap Beberapa Faktor Risiko yang Berpengaruh Terhadap

Kejadian Keracunan Pestisida pada Petani," Pena Med. J. Kesehat., vol. 6, no. 2, Art. no. 2, 2016, doi: 10.31941/pmjk.v6i2.397.

[2] R. Sumata, R. Rochmawati, dan I. Budiastutik, "Gambaran Penggunaan Pestisida oleh Petani Sayur dan Dampaknya terhadap Lingkungan Sekitar Pertanian di Kecamatan Rasau Jaya," JUMANTIK J. Mhs. Dan Peneliti Kesehat., vol. 3, no. 2, Art. no. 2, Des 2016, doi: 10.29406/jjum.v3i2.369.

[3] I. A. Cristea, R. N. Kok, dan P. Cuijpers, "The Effectiveness of Cognitive Bias Modification Interventions for Substance Addictions: A Meta-Analysis," PLOS ONE, vol. 11, no. 9, hlm. e0162226, Sep 2016, doi: 10.1371/journal.pone.0162226.

[4] S. Fuhrimann dkk., "Variability and predictors of weekly pesticide exposure in applicators from organic, sustainable and conventional smallholder farms in Costa Rica," Occup. Environ. Med., vol. 77, no. 1, hlm. 40–47, Jan 2020, doi: 10.1136/oemed-2019-105884.

[5] Y. E.- Nahhal, "Biochemical Changes Associated with Long Term Exposure to Pesticide among Farmers in the Gaza Strip," Occup. Dis. Environ. Med., vol. 04, no. 03, hlm. 72–82, 2016, doi: 10.4236/odem.2016.43009.

[6] B. R. Fitriadi dan A. C. Putri, "Metode-Metode Pengurangan Residu Pestisida pada Hasil Pertanian," J. Rekayasa Kim. Lingkung., vol. 11, no. 2, Art. no. 2, Des 2016, doi: 10.23955/rkl.v11i2.4950.

[7] S. Aroonvilairat, W. Kespichayawattana, T. Sornprachum, P. Chaisuriya, T. Siwadune, dan K. Ratanabanangkoon, "Effect of Pesticide Exposure on Immunological, Hematological and Biochemical Parameters in Thai Orchid Farmers— A Cross-Sectional Study," Int. J. Environ. Res. Public. Health, vol. 12, no. 6, hlm. 5846–5861, Mei 2015, doi: 10.3390/ijerph120605846.

[8] G.-H. Lee dan K.-C. Choi, "Adverse effects of pesticides on the functions of immune system," Comp. Biochem. Physiol. Part C Toxicol. Pharmacol., vol. 235, hlm. 108789, Sep 2020, doi: 10.1016/j.cbpc.2020.108789.

[9] L. Ayi-Fanou, "Influence of Pesticide on Biochemical and Hematological Parameters in Beninese Vegetable Farmers," J. Biol. Life Sci., vol. 9, hlm. 65, Feb 2018, doi: 10.5296/jbls.v9i1.12461.

[10] S. Karami-Mohajeri dan M. Abdollahi, "Toxic influence of organophosphate, carbamate, and organochlorine pesticides on cellular metabolism of lipids, proteins, and carbohydrates: A systematic review," Hum. Exp. Toxicol., vol. 30, no. 9, hlm. 1119–1140, Sep 2011, doi: 10.1177/0960327110388959.

[11] A.-A. Mardiyah, G. Sugihartina, M. Rahmat, dan M. F. Solihat, "Frekuensi Penyemprotan, Dosis Penggunaan Pestisida dan Perilaku Petani Penyemprot Terhadap Kadar Hemoglobin," J. Ris. Kesehat. Poltekkes Depkes Bdg., vol. 11, no. 1, Art. no. 1, Jul 2019, doi: 10.34011/juriskesbdg.v11i1.764.

[12] N. M. Arwin dan S. Suyud, "Pajanan pestisida dan kejadian anemia pada

petani holtikultura di Kecamatan Cikajang, Kabupaten Garut tahun 2016," Ber. Kedokt. Masy., vol. 32, no. 7, Art. no. 7, Mar 2018, doi: 10.22146/bkm.12313.

[13] J. L. Lu, "Comparison of pesticide exposure and physical examination, neurological assessment, and laboratory findings between full-time and part-time vegetable farmers in the Philippines," Environ. Health Prev. Med., vol. 14, no. 6, hlm. 345–352, Nov 2009, doi: 10.1007/s12199-009-0105-x.

[14] N. M. Arwin dan S. Suyud, "Pajanan pestisida dan kejadian anemia pada petani holtikultura di Kecamatan Cikajang , Kabupaten Garut tahun 2016," Ber. Kedokt. Masy., vol. 32, no. 7, hlm. 245–250, 2016.

[15] J. L. Lu, "Comparison of pesticide exposure and physical examination, neurological assessment, and laboratory findings between full-time and part-time vegetable farmers in the Philippines," Environ. Health Prev. Med., vol. 14, no. 6, hlm. 345–352, 2009, doi: 10.1007/s12199-009-0105-x.

[16] S. Aroonvilairat, W. Kespichayawattana, T. Sornprachum, P. Chaisuriya, T. Siwadune, dan K. Ratanabanangkoon, "Effect of pesticide exposure on immunological, hematological and biochemical parameters in thai orchid farmers— A cross-sectional study," Int. J. Environ. Res. Public. Health, vol. 12, no. 6, hlm. 5846–5861, 2015, doi: 10.3390/ijerph120605846.

[17] A. Siwiendrayanti, Suhartomo, dan N. E. Wahyuningsih, "Hubungan Riwayat Pajanan Pestisida Dengan Kejadian Gangguan Fungsi Hati (Studi pada Wanita Usia Subur di Kecamatan Kersana Kabupaten Brebes) Association Between Pesticides Exposure and Liver Disfunction (Study on women childbearing-age at Kecamatan Ker," J. Kesehat. Lingkung. Indones., vol. 11, no. 1, hlm. 9–14, 2012.