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The Analysis of SGOT, SGPT, and ALP in Chili Farmers Exposed to Pesticides in Kendalbulur Village, Tulungagung

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Abstract

Chili farmers in Kendalbulur Village are the main subjects that have a great influence due to exposure to pesticide residues (toxicity). Pesticide toxicity affects enzymes produced by the liver that cause changes in its working system. This study aims to look at the characteristics and levels of the enzymes SGOT, SGPT, and ALP in chili farmers exposed to pesticides that perform spraying activities. The SGOT-SGPT liver function test is a health screening that combines the examination of SGOT and SGPT enzyme levels in the blood. The purpose of this liver function test is to detect hepatitis or cirrhosis of the liver in chili farmers. The alkaline phosphatase (ALP) enzyme test is conducted to help diagnose and evaluate cirrhosis and inflammatory diseases of the liver. In addition to evaluating liver function, the alkaline phosphatase (ALP) enzyme test can also help detect bone disorders or protein deficiencies in chili farmers. Respondents were 20 chili farmers and pesticide users with an age range of 34–71 years. Test method using the non-analytical descriptive method and sampling technique using total sampling. The examination carried out is the rate of SGOT, SGPT, and ALP using spectrophotometry. The results of the SGOT examination showed that all respondents had SGOT levels in the normal range of <40 U/L, where the lowest result was 16 U/L and the highest was 35 U/L. While SGPT showed that all respondents were in the normal range of 40 U/L, with the lowest result of 2 U/L and the highest of 23 U/L, the ALP levels of many respondents were above normal values. The lowest value is 131 U/L, and the highest is 222 U/L. The results showed that the respondents showed disruption of the liver because ALP levels give high results. Where should ALP levels decrease with age.

Keywords: Pesticides, Chili, Farmers, SGOT, SGPT, ALP

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INTRODUCTION

Enhancing the agricultural sector necessitates a range of supportive resources to attain favorable outcomes, particularly in addressing the national economic requirements for food and clothing, either through exports or international distribution. These supportive resources for boosting crop yields in agriculture encompass farming equipment, fertilizers, and chemicals, including pesticides (Bukhtiarova et al., 2019). The agricultural sector plays a vital role in supplying food and raw materials to support other economic sectors, thereby serving as a catalyst for industrialization (Hidayah et al., 2022). In developing nations, the agricultural sector assumes a particularly vital role in driving economic growth and development when contrasted with advanced economies, which boast more diversified economic structures (Meyer, 2019).

The majority of residents in Kendalbulur Village rely on agriculture for their livelihood, using their farmland to support the local economy. Generally, farmers in this village prefer to grow food crops such as tobacco and chili peppers. Caring for chili plants requires considerable precision and routine due to their vulnerability to pests like fungi, caterpillars, and other insects that can damage the fruit. To address pest damage, farmers in Kendalbulur Village often use pesticides. This use of pesticides is driven by market demand and the relatively short life cycle of chili plants.

Pesticides can play a crucial role in enhancing the quality and yield of agricultural commodities in many countries where they remain predominant. Thoughtful pesticide use offers several advantages for humanity, including increased crop and livestock production by mitigating Plant Pests and Diseases (PPDs), ensuring the sustainability of food supplies through higher yields, improved human health, quality of life, and life expectancy thanks to the availability of high-quality food, as well as environmental enhancements. However, it is essential to acknowledge that pesticide use does come with adverse effects (Utama et al., 2022).

In the realm of agriculture, the utilization of pesticides has undeniably played a pivotal role in enhancing the production of horticultural crops. Pesticide use has been widely acknowledged as the most effective method for controlling pests and diseases (Ratu et al., 2021). Horticulture encompasses the intricate practices of cultivating various crops, including vegetables, fruits, medicinal plants, and ornamental plants. One specific example of horticulture is the cultivation of chili peppers (Lihiang et al., 2022).

Farmers sometimes employ pre-harvest spraying, which can result in the contamination of vegetables intended for consumption and pose health risks to humans. Consequently, residues are left behind, eventually finding their way into the human body, either directly or indirectly. Research on pesticide residues in vegetables has identified the presence of insecticides such as Diazinon, Chlorpyrifos, Phentoate, Carbaryl, and BPMC in cabbage and long beans sold at Badung Market in Denpasar. The levels of these residues are influenced by the quantity of insecticides used. Specifically, farmers use Chlorpyrifos at rates of 60-65% and Carbaryl at 40%. The residue levels in cabbage and long beans are as follows: Chlorpyrifos at 0.525 ppm and 1.296 ppm, and Carbaryl at 0.303 ppm and 0.471 ppm, respectively. Notably, the Chlorpyrifos residue levels in cabbage and long beans exceed the Maximum Residue Limit (MRL) set for vegetables, which is established at 0.5 ppm (Sari & Lestari, 2020). Exposure to the body by pesticides has an impact on the components in the human body, one of which is the liver. Pesticides can cause both chronic and acute liver damage if used in excess (Sukmayanti et al., 2020). The liver is one of the primary target organs for pesticides and plays a crucial role in responding to and metabolizing toxins that enter the body (Kumala & Agung, 2022). The accumulation of pesticides in the liver cannot be effectively metabolized or expelled from the body, resulting in an elevated presence of free radicals and disturbances in the permeability of hepatocyte cell membranes (Zahro et al., 2021).

Aspartate Aminotransferase (AST) or Serum Glutamic Oxaloacetic Transaminase (SGOT), Alanine Aminotransferase (ALT) or Serum Glutamic Pyruvic Transaminase (SGPT), Alkaline Phosphatase (ALP) are enzymes whose presence and levels in the blood are used as markers of impaired liver function. These enzymes are normally located inside the liver cells. Liver damage causes liver enzymes to be released into the bloodstream, increasing their levels in the blood and exacerbating liver dysfunction (Maretha et al., 2020). As a result of the accumulation of exposure to toxic chemicals in the composition of pesticides that enter the liver cannot be broken down and excreted and stored in the liver will cause disruption of liver cells or organelles. This results in damage to the liver parenchyma or impaired permeability of the liver cell membrane so that the enzymes freely exit the cells. In response to liver damage, the concentration of enzymes in the blood will increase which indicates a poisoning event (Tsani et al., 2017).

The habit of farmers in using pesticides that sometimes violate regulations, in addition to the doses used exceed the dose, farmers also often mix several types of pesticides, on the grounds of increasing their toxicity to plant pests (Jaya et al., 2017). Exposure to pesticides that have an impact on users, especially farmers, can be caused by a lack of understanding of techniques or proper use of pesticides such as improper dosing or often combining different types of pesticides under the pretext of increasing their toxicity. In addition, the use of personal protective equipment (PPE) that is not appropriate even at all is also very influential on pesticide exposure. So it is advisable in the use of pesticides, farmers are able to understand about the type and dose of pesticide use and the benefits of using the right Personal Protective Equipment (PPE). Therefore, the researchers were interested in analyzing the levels of SGOT, SGPT, and ALP in chili farmers exposed to pesticides in Kendalbulur Village.

METHOD

Transaminase enzymes include alanine transaminase (ALT) or serum glutamate pyruvate transferase (SGPT) and aspartate transaminase (AST) or serum glutamate oxaloacetate transferase (SGOT). Measuring the activity of SGPT and SGOT in the serum can indicate specific liver cell abnormalities. Although these measurements are not true liver function tests, they are still recognized as liver function tests(Rosida, 2016). Liver dysfunction can result in elevated levels of SGPT (Serum Glutamic Pyruvic Transaminase) and ALP (Alkaline Phosphatase) (Sukmayanti et al., 2020).

Sample Collection

The samples used in this study were all farmers in Kendalbulur village who were exposed to pesticides. The sampling technique is done by using the total sampling method. The reason for taking total sampling is because the population is less than 100. The sample size in this study was 20 chili farmers.

Sample Preparation

The blood in the tube is left until it coagulates, then the sample is centrifuged at 3500 rpm for 10 minutes to separate the serum. The Serum formed is then used for examination of SGOT, SGPT and ALP levels.

Examination Procedure

SGOT (Serum Glutamic Oxaloacetic Transaminase) is measured using the Kinetic Enzymatic method according to IFCC (International Federation of Clinical Chemistry and Laboratory Medicine) standards

SGOT in the sample catalyzes the transfer of an amino group from L-aspartate to 2-oxoglutarate, forming oxaloacetate and L-glutamate. Oxaloacetate is then reduced to L-malate in the presence of NADH and malate dehydrogenase (MHD). During this reaction, NADH is oxidized to NAD+. The rate of decrease in absorbance at 340 nm is monitored to measure the oxidation of NADH to NAD+. Lactate dehydrogenase (LDH) is added to the reagent to prevent interference from endogenous pyruvate typically present in serum (Nugraha, 2022).

The sample, working reagent, and control reagent are adjusted to room temperature before the examination begins. Regulated and adjusted photometer absorption to a value of 0 by using water distillation. Pipetted into the cuvette of each reagent and sample according to the temperature listed: 37 °C, then used a ratio of 1.0 mL of reagent and 50 µL of working sample. Mixed evenly, then put the cuvette into the holder on the spectrophotometer, and the stopwatch is turned on. Incubated for 1 minute and recorded data from the readings. Absorbance readings repeat exactly after 1, 2, and 3 minutes. Calculate the difference between each absorption. Calculate the entire result to get the average change in absorption per minute (ΔA/min). Spectrophotometers are used to analyze a wide range of compounds compared to other analytical methods. In addition, it is practical for sample preparation.

SGPT (Serum Glutamic Pyruvic Transaminase) is measured using the Kinetic Enzymatic method according to IFCC (International Federation of Clinical Chemistry and Laboratory Medicine) standards

SGPT (Serum Glutamic Pyruvic Transaminase) enzyme catalyzes the reversible transfer of an amino group from L-alanine to 2-oxoglutarate in a buffered solution, producing pyruvate and L-glutamate. The pyruvate is then reduced to lactate in the presence of LDH (Lactate Dehydrogenase), accompanied by the oxidation of NADH to NAD+. The reaction progress is monitored by measuring the rate of decrease in absorbance due to NADH oxidation. To prevent interference during testing, endogenous pyruvate in the sample is rapidly reduced by LDH during an initial incubation period.

Samples, working reagents, and control reagents are equilibrated to room temperature before the examination begins. The spectrophotometer absorbance is set and adjusted to 0 using distilled water. Each reagent and sample is pipetted into cuvettes at the specified temperature (37°C), with a ratio of 1.0 mL SGPT reagent to 50 µL sample. After thorough mixing, the cuvette is placed in the spectrophotometer holder, and the stopwatch is started. The mixture is incubated for 1 minute, and absorbance readings are recorded. Absorbance readings are then repeated at 1, 2, and 3 minutes. The difference in absorbance for each time interval (ΔA/minute) is calculated and averaged to determine the overall rate of absorbance change per minute.

ALP (Alkaline Phosphatase) is measured using the Enzymatic method

This method is in accordance with recommendations from the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC). Alkaline phosphatase catalyzes the hydrolysis of 4-nitrophenylphosphate (4-NPP), producing free 4-nitrophenol and inorganic phosphate, with an alkaline buffer serving as a phosphate acceptor. The reaction kinetics are monitored at 405 nm, measuring the rate of 4-nitrophenol formation, which correlates with the activity of ALP in the sample. The test follows a standardized method outlined by DGKC.

Before the examination begins, samples, working reagents, and control reagents are equilibrated to room temperature. The spectrophotometer is zeroed using distilled water. Each reagent and sample is pipetted into cuvettes at the specified temperature (37°C), with a ratio of 1.0 mL ALP reagent to 20 µL sample. After thorough mixing, the cuvette is placed in the spectrophotometer holder, and the stopwatch is started. The mixture is incubated for 1 minute, and absorbance readings are recorded. Absorbance readings are then repeated at 1, 2, and 3 minutes. The difference in absorbance for each time interval (ΔA/minute) is calculated and averaged to determine the overall rate of absorbance change per minute.

RESULTS AND DISCUSSION

Based on Figure 1, the results of observations obtained respondents chili farmers exposed to pesticides in Kendalbulur village majority aged 36-45 years a number of 7 people.

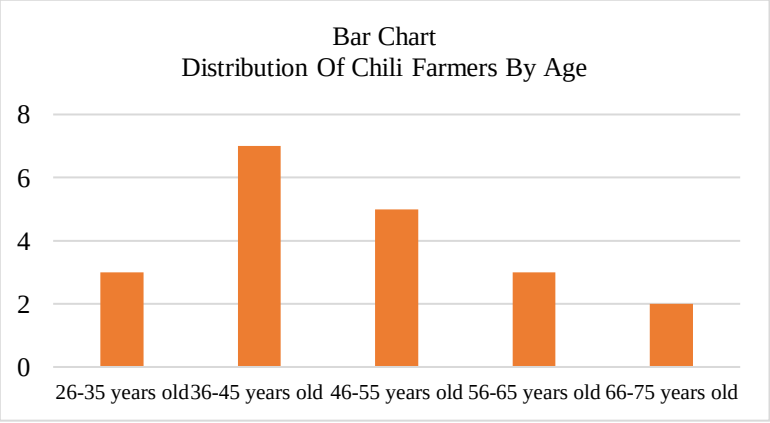

Figure 1. Distribution of Respondents of Chili Farmers Exposed to Pesticides in Kendalbulur Village by Age

Based on Figure 2, obtained from observations of chili farmers exposed to pesticides in Kendalbulur village majority exposed to pesticides for more than 5 years a number of 20 people (100%).

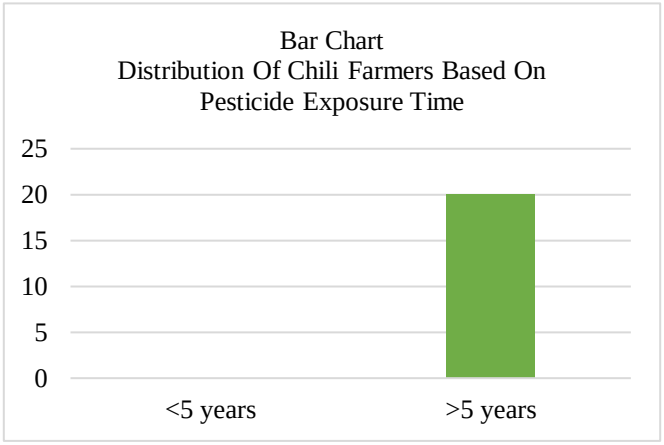

Figure 2. Distribution of Respondents of Chili Farmers Exposed to Pesticides in Kendalbulur Village Based on The Duration of Pesticide Use

Based on Table 1 obtained results of analysis of SGOT levels with normal values of 20 people (100%) who have an average level of 27.6 U/L. The results of the analysis of SGPT levels with normal values of 20 people (100%) who have an average level of 10.25 U/L and the results of the analysis of ALP levels above normal values in all respondents with an average value of ALP levels in respondents of 171.6 U/L.

Table 1. The Results of SGOT, SGPT, and ALP Levels

Sample Code	Age	SGOT Levels (U/L)	SGPT Levels (U/L)	ALP Levels (U/L)
Code 1	48	28	14	182
Code 2	34	21	8	182
Code 3	32	28	6	168
Code 4	48	21	11	147
Code 5	52	24	4	161
Code 6	58	16	2	182
Code 7	71	26	9	172
Code 8	44	31	10	208
Code 9	39	31	20	202
Code 10	69	39	11	148
Code 11	38	28	9	167
Code 12	42	19	5	179
Code 13	45	35	20	131
Code 14	48	35	23	149
Code 15	48	38	10	222
Code 16	40	23	5	136
Code 17	45	30	9	146
Code 18	34	32	22	218
Code 19	60	23	9	165
Code 20	60	23	7	167
Total		**552**	**205**	**3432**
Average		**27,6**	**10,25**	**171,6**

Based on data obtained from observations of respondents, chili farmers in Kendalbulur village who work as pesticide sprayers are adults to the elderly which shows that despite their advanced age there are some farmers who are still active in pesticide spraying activities.

Based On Figure 2. it is known that the working period or duration of pesticide use by all chili farmers in Kendalbulur Village is 5 years, a number of 20 people (100%). From the results obtained SGOT levels showed that all respondents, namely chili farmers have normal SGOT levels. Where the average value is 10.25 U/L. According to Fatimatus (2021) there are other factors that result in the absence of a meaningful relationship between pesticide exposure and SGOT levels, this is based on the type of pesticide used. For example, organophosphate and carbamate pesticides have a moderate level of toxicity so that the accumulation effect is milder and especially if they are used with a fairly low frequency (Zahro et al., 2021).

Analysis of the data showed the highest value of all the results of the examination on the sample with the number 14 showed results with a rate of 23 U/L. Based on observations that have been made, respondent number 14 is a man, using pesticides 1 time in 7 days with a period of work as a pesticide user farmers 15 years. This result is not in line with the research conducted by Putri on vegetable farmers in Alebo Village, Konda District, South Konawe Regency which states that from the Serum Glutamic Pyruvic Transaminase (SGPT) examination study, with a total of 32 samples, there was an increase in SGPT levels by 8 vegetable farmers with a percentage of 25% (Putri, 2018).

In his research on farmers in Sumberejo Village, Ngablak District, Magelang regency, it was stated that there were 10 out of 15 farmers who felt complaints such as weakness, pallor, dizziness, nausea, and pain in the upper right abdomen. There were 6 out of 15 peasants who showed icteric in his eyes. Based on the results of observations that have been done, it is known that all respondents did not show symptoms of toxicity or impaired liver function, allowing all examination results to show normal levels (Tsani et al., 2017).

With regard to the working life of farmers, this is not in line with the research conducted by Tsani which states that working life can affect liver function disorders because the longer the farmer becomes a spraying farmer and the longer the contact with pesticides can cause pesticides to accumulate in the body. Based on observations that have been made, it is known that the working period of chili farmers in Kendalbulur village is a majority of >5 years which indicates that the accumulation of pesticide toxins in the body is increasing so that there is an assumption that prolonged exposure to pesticides can affect liver damage disorders. However, this is not in accordance with the results of a study conducted by researchers who showed normal levels of all samples of respondents (Tsani et al., 2017).

ALP is present in different organs including the placenta, ileal mucosa, kidney, bone, and liver, but its concentrations vary. The liver and bone contribute more than 80% of the ALP found in serum, while the intestine contributes minimally (Vimalraj, 2020). The ALP levels of the samples examined gave values above normal, with an average of 171.6 U/L. ALP levels may increase if there is minor damage to liver cells and the increase will be seen in acute liver disease. ALP becomes one of the biosensors in detecting pesticides in addition to cholinesterase enzymes. Elevated ALP levels are not necessarily caused by pesticides, other factors can be caused by bile duct obstruction, cirrhosis, hepatitis, and other liver infiltration diseases (Wasdli et al., 2022). ALP (Alkaline Phosphatase) is an enzyme categorized as a hydrolase, primarily synthesized by hepatic epithelial cells and osteoblasts (cells responsible for the formation of new bone). This enzyme is predominantly localized in the liver (referred to as isoenzyme ALP-1) and bones (referred to as isoenzyme ALP-2). It is also produced to a lesser extent by cells in the gastrointestinal tract, placenta, and kidneys. The normal range for ALP levels typically falls within 30 to 115 IU/L (Hendriani et al., 2020).

SGOT is an enzyme found in the heart muscle and liver, and in moderate concentrations in skeletal muscle, kidneys, and pancreas. On the other hand, SGPT is an enzyme predominantly found in liver cells and is effective for diagnosing hepatocellular damage

(Syalia et al., 2022). The SGPT and SGOT levels in farmers are typically within normal ranges because the liver effectively metabolizes and biotransforms all chemicals, including nutrients and xenobiotics like pesticides, present in the bloodstream. This efficient biotransformation process in the liver reduces or eliminates their concentrations in the bloodstream before they can reach other organs (Widarti & Nurqaidah, 2019). The liver assumes a pivotal role in the metabolism and detoxification of a wide array of foreign substances referred to as xenobiotics. These substances encompass medications, chemicals, contaminants, and components found in food. Xenobiotics, being foreign compounds that enter the body through various routes, are predominantly subjected to biological transformation within the liver (Rai et al., 2023). In the process of biotransformation, these chemicals undergo conversion into metabolites that are hydrophilic in nature and thus more readily excretable (Singh et al., 2022). The enzyme cytochrome P450 (CYP450) holds a pivotal position among the key enzymes engaged in this process. This enzyme transforms xenobiotics into water-soluble molecules that can be readily excreted from the body. Moreover, P450 enzymes modulate the efficiency and effectiveness of xenobiotic detoxification while actively participating in the oxidative metabolism of various endogenous compounds like steroids, fatty acids, and bile acids. Additionally, they play a crucial role in the metabolism of exogenous substances, including pharmaceuticals, environmental pollutants, and carcinogens (Rai et al., 2023).

Liver function assessments, including specific tests for parenchymal liver inflammation, involve measuring Serum Glutamic Oxaloacetic Transaminase (SGOT), also known as Aspartate aminotransferase (AST), and Serum Glutamic Pyruvic Transaminase (SGPT), also known as Alanine aminotransferase (ALT). These tests are conducted to identify the presence of liver inflammation (Khairani et al., 2022).

CONCLUSION

Based on the results of research conducted to determine the levels of SGOT, SGPT and ALP in chili farmers in Kendalbulur Village, SGOT and SGPT levels in chili farmers are at normal values. Where the average levels of SGOT 27.6 U/L and SGPT levels 10.25 U/L. While ALP levels showed a high average value, which is 171.6 U/L. This increase in ALP levels indicates if a person has a liver disorder and needs further examination. Farmers should always wear a mask and wash their hands after work.

RECOMMENDATION

For future research, it is recommended to include additional liver function tests such as Bilirubin, Albumin, and Globulin. Researchers should also pay attention to the use of personal protective equipment by farmers during pesticide mixing and spraying activities.

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