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EFFECT OF DIPLAZIUM ESCULENTUM ON CHOLINESTERASE, PARAOXONASE-1 AND MALONDIALDEHID ACTIVITIES ON VEGETABLE FARMERS USING PESTICIDES

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ABSTRACT
BACKGROUND: The use of pesticides in the world is currently increasing and even uncontrolled and poses a risk of pesticide poisoning for farmers. Diplazium esculentum is a biodiversity in Indonesia and contains active compounds include steroids, triterpenoids, phenols, flavones and high antioxidant potential, which contains flavonoid compounds that have the potential to reduce pesticide poisoning.
AIM: This study aims to determine the effect of Diplazium esculentum on enzyme cholinesterase activity, paraoxonase-1 (PON1) activity and malondialdehyde (MDA) activity in farmers exposed to pesticides.
METHODS: This study uses a Randomized Controlled Trial (RCT) experimental design, in which the researcher allocates research samples to the experimental group and the control group randomly based on the criteria determined by the researcher, double-blind. Examination of Cholinesterase Activity, Paraoxonase-1 (PON1) and Malondialdehyde (MDA) Test with Enzyme-linked Immunosorbent Assay (ELISA) method. The population in this study were all pesticide-using vegetable farmers in Kanreapia Village, Tombolopao District, Gowa Regency, which consisted of 375 people. While the number of samples was 42 people (21 people in the intervention group and 21 people in the control group).
RESULTS: Based on the paired t test, the value in the intervention group was p = 0.004 and the control p = 0.032 and the results of the unpaired t test obtained a significance value of p = 0.047 which means there is an effect of giving Diplazium esculentum activity cholinesterase The results of the Wilcoxon paraoxonase-1 showed that the value in the intervention group was p=0.005 and the control group p=0.520.test Mann Whitney U obtained a significance value of p = 0.043 which means that there is an effect of giving Diplazium esculentum levels paraoxonase-1 Whereas Wilcoxon malondialdehyde (MDA) The value in the intervention group was p=0.424 and the control p=0.375.test Mann Whitney U showed a significance value of p=0.242,

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which means that there was no significant effect of giving Diplazium esculentum levels malondialdehyde in pesticide-using vegetable farmers.
CONCLUSIONS: There is an effect of Diplazium esculentum on enzyme cholinesterase, and paraoxonase-1 (PON1) activity, and there is no effect of Diplazium esculentum on malondialdehyde (MDA) in farmers exposed to pesticides.

Keyword: Diplazium esculentum; enzyme cholinesterase, paraoxonase-1 (PON1) activity; malondialdehyde (MDA) in farmers exposed to pesticides

PRELIMINARY

The use of pesticides in the world is currently experiencing an increasing development. The use of pesticides in agriculture is increasing rapidly in developing countries, especially in Southeast Asia, WHO has reported that about 20% of pesticides are used in developing countries with increasing use by communities [1]. Pesticides pose an environmental threat related to their exposure through residues in food and drinking water as well as other media [2]. Pesticides are toxic materials that can cause resistance, resurgence, the emergence of new pests, and health problems for humans and other living things, so they must be managed carefully [3].

According to WHO, there were 107,705 cases of people dying in 2015 due to accidental poisoning [4]. Most cases of pesticide poisoning are estimated to occur among low-income communities and developing countries. Chronic exposure to pesticides has been associated with several health conditions, such as cancer, amyotrophic lateral sclerosis (ALS), asthma, type II diabetes and others [5]. In Indonesia, information on the incidence of pesticide poisoning in 2016, there were 771 cases of pesticide poisoning in all provinces in Indonesia. There are 3200 brands of pesticides registered with the Ministry of Agriculture, the most widely used are insecticides.

Research conducted in 2015 related to organophosphate pesticide residues of the profenofos type in tomatoes showed that the average concentration of profenofos in tomatoes was 0.37003 mg/kg. exceeds the 2006 US-EPA RfD standard of 0.005 mg/kg/day (Lagu, Habibi and Basri, 2015) When a pesticide enters the body, it will bind to the cholinesterase bond irreversible enzyme cholinesterase cannot hydrolyze acetylcholine. Chronic exposure to organophosphates in the body can lead to decreased levels of the PON1 enzyme [7].

The results of observations on farmers handling organophosphate and carbamate pesticides in 27 provinces of Indonesia showed that 61.8% of farmers had cholinesterase, 1.3% severe poisoning and 26.9% mild poisoning. Measurement cholinesterase in the blood is carried out to monitor pesticide poisoning at the farm level. In 2012 a study was conducted to assess the levels of the enzyme Cholinesterase related to the use of personal protective equipment (PPE). The group using PPE had a positive effect on increasing levels of the cholinesterase enzyme.

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In the human body there is an antioxidant serum enzyme PON1 (Paraoxonase 1) which functions as an anti-inflammatory, anti-oxidative, anti-atherogenic, anti-diabetic, anti-microbial and magmalike organophosphate hydrolysis properties. When a pesticide enters the body, it will bind to the cholinesterase bond irreversible enzyme cholinesterase cannot hydrolyze acetylcholine. Chronic exposure to organophosphates in the body can lead to decreased levels of the PON1 enzyme [7].

PON1 functions to hydrolyze paraoxon, a toxic oxon metabolite of the insecticide parathion. PON1 is synthesized by the liver, secreted into the blood, and binds to HDL particles [8]. Research related to the correlation between Paraoxonase-1 and cholinesterase associated with organophosphate pesticide exposure showed that high PON1 enzyme activity could minimize the effects of organophosphate pesticides [9]. Increased ROS and free radicals can cause oxidative stress conditions and trigger lipid peroxidation in cell membranes which will produce malondialdehyde (MDA)[9].

Intensive pesticide exposure can affect the hydrolysis ability of the enzyme paraoxonase 1 (PON1) so that it triggers the occurrence of Reactive Oxygen Species(ROS), namely free radicals in the form of oxygen and its highly reactive derivatives. In cells, reactive oxygen species(ROS) will bind to polyunsaturated fatty acids (PUFA) and produce malondialdehyde (MDA). Malondialdehyde ($CH_2(CHO)_2$) is a reactive aldehyde organic compound that can cause toxic stress in cells and form protein plugs in cells. The continuous increase in ROS production can cause oxidative stress that can cause cell damage. Oxidative stress can be monitored by looking at changes in malondialdehyde [10]. In addition, the body will produce the serum enzyme Paraoxonase-1 (PON1) as a reaction to pesticide exposure in the body.

Vegetable spikes (Diplazium esculentum) are one of the biodiversity that are often used by the community, not only consumed as delicious food, raw vegetables, or salads but for some people also consider it has various properties to cure various diseases. Vegetable spikes (Diplazium esculentum) contain active compounds include steroids, triterpenoids, phenols, flavones, and flavonoids [11]. An in vitro study of antioxidant activity in Diplazium esculentum showed that the antioxidant content reached 27.4% to 33.22% with ferric thiocyanate (TBC) and thiobarbituric acid (TBA) tests [12]. In another study, Diplazium esculentum had antimicrobial and cytotoxic activity. The antioxidant potential of Diplazium esculentum is that it contains flavonoid compounds. It is proven that Diplazium esculentum can be used as natural antioxidants, antimicrobial and cytotoxic agents [13].

Flavonoids are one of the most secondary metabolites consumed by humans as antioxidants that fight free radicals, and have been shown to reduce the risk of PTM. Research on subjects aged 19 years showed that flavonoid intake was able to reduce the risk of cancer 41%, CHD 18%, hypertension 9%, DM 8%, heart failure 19%, and stroke 10% [14]. Antioxidant activity test of Diplazium esculentum in vivo in rats showed that the hydroalcoholic extract of Diplazium esculentum reduce the level of lipid peroxidation and the level of antioxidant enzymes enough to return to normal. In vitro antioxidant activity

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test of leaf hydroalcohol Diplazium esculentum (DEHAe) in neutralizing free radicals with reference to ascorbic acid as a standard. Shows that the IC50 value of antioxidant activity was found to be 138.8 mg/mL and 125.2 mg/mL of ascorbic acid [15].

Diplazium esculentum has been shown to contain antioxidant compounds, can be anti-inflammatory, anti-bacterial, anti-diabetic, reduce the risk of hyperlipidemia, Hepatoprotective (liver protector) is a medicinal compound that has a therapeutic effect, to restore, maintain, and treat damage to liver function so that Diplazium esculentum can be consumed as a vegetable choice [15]. However, until now there has been no research related to the antioxidant Diplazium esculentum which is correlated with levels of the enzyme cholinesterase, PON1 and MDA in humans. Research related to the toxicity and phytochemical Diplazium esculentum shows that the Diplazium esculentum non-toxic and safe for human use [16].

METHODS

Experimental research design Randomized Controlled Trial , where the researcher allocated the research sample to the experimental group and the control group randomly based on the criteria determined by the researcher. Then a double-blind study was assessed, where neither the researcher nor the sample knew the status of the sample whether it was in the intervention group or the control group. The strength of this design can minimize confounding factors that can cause bias in research results.

The design of this study seeks to determine (the effect of Diplazium esculentum on activity of cholinesterase, paraoxonase-1 (PON1) and malondialdehyde (MDA) enzymes in vegetable farmers using pesticides, causal relationship by involving the control group in addition to the intervention group. In this design, the intervention group was given a fern tea product (paku Sayur)/ Diplazium esculentum , while the control group was given a placebo. In both groups, it was started with a pre-test and after the treatment was given a re-measurement (post-test). Examination of Cholinesterase Activity, Paraoxonase-1 (PON1) and Malondialdehyde (MDA) Test with Enzyme-linked Immunosorbent Assay (ELISA) method.

The population in this study were all pesticide-using vegetable farmers in Kanreapia Village, Tombolopao District, Gowa Regency, which consisted of 375 people. The number of samples in this study were 42 people (21 people in the intervention group and 21 people in the control group). The research subjects were members of the study population who met the inclusion requirements as samples.

This research has been carried out in Kanreapia Village, Tombolopao District, Gowa Regency, starting from June 2020 to December 2021, after obtaining a recommendation for approval from the Health Research Ethics Committee, Faculty of Medicine, Hasanuddin University with registration number 270/UN4.6.4.5.31/PP36/2021.

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RESULTS

Table 1

Effect of Administration of Diplazium esculentum on Activity Cholinesterase in Pesticide User Vegetable Farmers

Activity Cholinesterase (mU/ml)	Mean±SD Pre-test	Mean±SD Post-test	Δ	P*	P**
Intervention (n= 21)	3.56±0.91	4.57±1.20	1.01	0.004	0.04
Control (n= 21)	3.57±0.76	3.89±0.96	0.31	0.032	7

P* = Paired T-Test,P** = Unpaired T-Test

Table 1 shows the results of Diplazium esculentum activity cholinesterase. Both groups experienced an increase after the intervention. In the intervention group the mean±SD pre-test was 3.56±0.91 mU/ml, while the mean±SD post-test increased to 4.57±1.20 mU/ml. In the control group, the pre-test Mean±SD value was 3.57±0.76 mU/ml. Meanwhile, the mean±SD post-test increased by 3.89±0.96 mU/ml. The mean value of the increase in the group was 1.01 mU/ml. Meanwhile, the average increase in the control group was only 0.31 mU/ml.

Based on the paired t test, it was found that the significance value in the intervention group was p = 0.004 and the control p = 0.032 which indicated an increase in cholinesterase in the intervention and control groups. The results of the unpaired t test obtained a significance value of p = 0.047 which means that the increase in cholinesterase the intervention group is greater than the control group, or there is an effect of giving Diplazium esculentum activity cholinesterase in vegetable farmers using pesticides in Kanreapia Village, Tombolopao District, Gowa Regency.

Table 2.

The Effect of Diplazium esculentum on Paraoxonase-1 in Pesticide-Using Vegetable Farmers

Paraoxonase-1 Levels (ng/ml)	Median Pre-test	Median Post-test	Δ	P*	P**
Intervention (n= 21)	50.42	61.74	22.12	0.005	0.043
Control (n= 21)	40.25	36.89	5.42	0.520	

P* = Wilcoxon test, P** = Mann Whitney U test

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Table 2 shows the results of Diplazium esculentum levels paraoxonase-1. The intervention group experienced an increase after the intervention, while the control group experienced a decrease. In the intervention group, the pre-test median value was 50.42 ng/ml, while the post-test median value increased to 61.74 ng/ml. In the control group, the median pre-test value was 40.25 ng/ml. Meanwhile, the post-test median value decreased by 36.89 ng/ml. The average value of the increase in the intervention group was 22.12 ng/ml. Meanwhile, the average value in the control group decreased by only 5.42 ng/ml.

Based on the Wilcoxon test, the significance value in the intervention group was p=0.005 , indicating an increase in paraoxonase-1 while in the control group, p=0.520 , indicating no increase in paraoxonase-1.test Mann Whitney U obtained a significance value of p = 0.043 which means that the increase in paraoxonase-1 the intervention group is greater than the control group, or there is an effect of giving Diplazium esculentum on paraoxonase-1 in pesticide-using vegetable farmers in Kanreapia Village, Tombolopao District, Gowa Regency.

Table 3.

The Effect of Diplazium esculentum on Malondialdehyde

in Vegetable Farmers Using Pesticides

Malondialdehyde Level (nmol/ml)	**Median Pre-test**	**Median Post-test**	**Δ**	**P***	**P****
Intervention (n= 21)	7.88	6.09	-0.76	0.424	0.242
Control (n= 21)	5.54	6.41	0.91	0.375	

P* = Wilcoxon test, P** = Mann Whitney U test

Table 3 shows the results of Diplazium esculentum levels malondialdehyde. The intervention group experienced a decrease after the intervention, while the control group did not experience a decrease in malondialdehyde. In the intervention group, the median pre-test value was 7.88 nmol/ml, while the post-test median value decreased to 6.09 nmol/ml. In the control group, the median pre-test value was 5.54 nmol/ml. Meanwhile, the post-test median value increased by 6.41 nmol/ml. The mean value of reduction in the intervention group was -0.76 nmol/ml. Meanwhile, the average value in the control group increased by 0.91 nmol/ml.

Based on the Wilcoxon test, the significance value in the intervention group was p=0.424 , indicating a decrease in malondialdehyde , while in the control group, p=0.375 , indicating an increase in malondialdehyde.test Mann Whitney U obtained a significance value of p = 0.242 which means that the decrease in malondialdehyde in the intervention

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group was larger than the control group, statistically it showed no significant effect of giving Diplazium esculentum levels malondialdehyde in pesticide-using vegetable farmers in Kanreapia Village, Tombolopao District, Gowa Regency.

DISCUSSION

Effect of Administration Diplazium esculentum on Cholinesterase Activity

Analysis of the level of poisoning can not only be known by looking at the symptoms of poisoning, but also cholinesterase activity in the blood. According to the World Health Organization, a 30% decrease in cholinesterase activity from normal can be declared as poisoning. The results showed that there was an effect of giving Diplazium esculentum on cholinesterase activity and the increase in activity of the intervention group was greater than that of the control group. The intervention group experienced an increase in the mean±SD value from 3.56±0.91 mU/ml increasing to mean±SD 4.57±1.20 mU/ml. The control group experienced an increase in the mean±SD value from 3.57±0.76 mU/ml to mean±SD 3.89±0.96 mU/ml.

Diplazium esculentum is the most commonly consumed fern/spike vegetable throughout Asia.extract Diplazium esculentum has been shown to inhibit the enzymes acetylcholinestrase and nicotinamide adenine dinucleotide (NADH) and can be a high antioxidant and free radical scavenger (Kumar Y et al, 2015). Extracts from Diplazium esculentum contain natural antioxidants that can help prevent the development of neurodegenerative disorders associated with oxidative stress and poisoning

Diplazium esculentum is traditionally used for the prevention or treatment of several diseases such as diabetes, smallpox, asthma, diarrhea, rheumatism, dysentery, headaches, fever, wounds. , pain, measles, hypertension, constipation, oligospermia, fractures, and swollen glands [17]. Diplazium esculentum has antioxidant, antimicrobial, antidiabetic, immunomodulatory and antianaphylactic properties[18]. And contains a large number of flavonoid and phenolic compounds which are quite high.

The results showed that the test on mice with Diplazium esculentum significantly reduced the level of lipid peroxidation. The level of antioxidant enzymes, namely catalase and glutathione also decreased significantly and this indicates that the antioxidant is very strong in Diplazium esculentum [15]. The methanol extract of Diplazium esculentum also has radical scavenging activity against a variety of reactive oxygen species (ROS) and reactive nitrogen species (RNS), including hydroxyl, superoxide, hydrogen peroxide, singlet oxygen, hypochlorous acid, nitric oxide and peroxynitrite.extract Diplazium esculentum has reducing strength and lipid peroxidation inhibition property. In addition, Diplazium esculentum is reported to contain compounds that have good potential for antioxidants and their effects on nutrition and human health are quite large [19].

The results of previous studies showed that 70% extract of acetylcholinesterase and NADH oxidase in a dose-dependent manner, with IC50 values of 272.97±19.38 and 265.81±21.20 g/mL, respectively. The extract also showed strong DPPH radical activity

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with an IC50 value of 402.88±12.70 g/mL. In addition, the extract showed 27.41% and 33.22% total antioxidant activity as determined by the FTC and TBA methods, respectively [12].

The results of this study indicate the activity of cholinesterase in the intervention group was greater than in the control group.examination cholinesterase aims to determine poisoning or pesticide exposure in the farmer's body. activity cholinesterase enzymes cholinesterase in blood plasma and red blood cells that play a role in maintaining the balance of the nervous system. Blood cholinesterase levels can be disturbed when spraying because of organophosphate and carbamate pesticides. These pesticide groups will bind to the cholinesterase, so that cholinesterase becomes inactive and becomes an accumulation of achethilcholine. This situation will cause a nervous system disorder in the form of an increase in cholinergic continuously due to achethicholine that is not hydrolyzed. This disorder is then known as a sign or symptom of poisoning which does not only occur in nerve endings but also in nerve fibers [20].

Enzyme cholinesterase is an enzyme found in cellular fluids whose function is to stop the action of acetylcholine by hydrolyzing it into choline and acetic acid.enzyme cholinesterase in a person's blood is expressed as a percentage of cholinesterase in the blood, the diagnosis of poisoning is 75-100% including "normal", 50-75% including mild poisoning, 25-50% including moderate and 0-25% including severe poisoning. The use of pesticides to control plant pests carries the risk of accidents to humans in the form of chronic, acute poisoning and death, the severity of the poisoning level is related to the level of cholinesterase in the blood. The symptoms that arise in farmers with pesticide poisoning are fatigue, excessive weakness, burning skin, excessive sweating, discoloration of the skin, blurred vision, small and enlarged eyes, nausea, vomiting, diarrhea, stomach cramps or abdominal pain. difficulty breathing, chest pain and others [21].

Effect Administration of Diplasium esculentum on Paraoxonase-1 Levels

The results showed that there was an effect of administering Diplazium esculentum on levels of paraoxonase-1 (PON1)intervention group paraoxonase-1 was greater than that of the control group. The intervention group experienced an increase from the median of 50.42 ng/ml to a median of 61.74 ng/ml while the control group experienced a decrease from the median value of 40.25 ng/ml to a median value of 36.89 ng/ml. Decreased PON1 is influenced by the level of pesticide exposure and is associated with an increased risk of cardiovascular events and plays a role in several human diseases including diabetes mellitus and atherosclerosis [22].

Paraoxonase-1 (PON1) is a high-density lipoprotein-associated esterase and is thought to play a role in several diseases including diabetes mellitus and atherosclerosis. Low PON1 activity has been associated with an increased risk of major cardiovascular events. PON1 is very important for the body because it can act as an antioxidant, anti-inflammatory and antiapoptotic. PON1 has the ability to hydrolyze specific

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organophosphate (OP) compounds and prevent the accumulation of oxidized lipids in lipoproteins. Previous studies have shown that PON1 can modulate toxicity and disease [23]. To deal with the decrease in paraoxonase, one alternative that can be done is by consuming foods containing phenolic compounds and carotenoids [24]. Phenolic compounds and carotenoids have been proven in the content of vegetable fern (Diplazium esculentum) and other compounds that have natural antioxidants that are good for the body.

PON1 is a high-density lipoprotein-associated esterase and plays a role in several human diseases including diabetes mellitus and atherosclerosis. Low PON1 activity has been associated with an increased risk of cardiovascular events. PON1 is an HDL-associated protein that has the ability to hydrolyze oxidized LDL-cholesterol, with potential atheroprotective effects[22]. Previous studies were tested on mice using PON-1 in atheroprotective treatment using Rattus norvegicus and compared transgenic mice and wild mice. The results showed that transgenic mice overproduced PON-1 and prevented atherosclerosis, when compared to wild-type mice. Moreover, PON-1-deficient mice are at greater risk of developing atherosclerosis than wild-type mice [22].

PON1 was found to be an enzyme that hydrolyzes organophosphates and consists of PON1, PON2 and PON3. The results of the study showed that the activity of the paraoxonase showed the presence of esterase and lactonase/k. lactonizing activity [25]. Hydrolysis of homocysteine thiolactone by PON1 has been shown to be protective against coronary artery disease, PON 1 significantly indicates the presence of a protein that is responsible for HDL antioxidants [26].

In vitro studies conducted by Gouedard et al showed that polyphenolic compounds caused an increase in PON1 mRNA expression. Polyphenols from pomegranate also increase PON1 enzyme mRNA expression and protect HDL and LDL from oxidation. Polyphenol compounds can increase the number of PON-1 enzymes which then act as natural antioxidants that protect the body from oxidation, HDL and LDL [27].

Effect of giving Diplazium esculentum on levels of Malondialdehyde

Malondialdehyde (MDA) is the end product of lipid peroxidation which is toxic, so that high levels of MDA can interfere with body health. Exposure to pesticides directly or indirectly can cause cell damage and even gene mutations because pesticides can cause an imbalance in the number of free and antioxidants where the number of free radicals increases and antioxidants decreases, resulting in oxidative stress through the lipid peroxidase pathway. In the lipid peroxidase pathway, free radicals that bind to unsaturated fatty acids (PUFA = Poly Unsaturated Fatty Acid) will form Malondialdehyde (MDA) which is often used as a marker of oxidative stress. The use of organophosphate pesticides has been shown to increase levels of malondialdehyde (MDA) which is a marker of lipid peroxidation and decrease the work function of catalase (CAT), superoxide dismutase (SOD), and glutathione peroxidase (GSH-Px). So that exogenous antioxidants are needed that will help the performance of endogenous antioxidants in the body to

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detoxify toxins that enter the body, in this study fern tea supplements were used to detoxify toxins in vegetable farmers who use pesticides.

The results of the research conducted showed that there was no statistically significant effect of giving diplazium esculentum levels malondialdehyde in pesticide-using vegetable farmers, but there was a decrease in the median value in the intervention group from 7.88 nmol/ml to 6.09 nmol/ml. Meanwhile, in the control group, the median value increased from 5.54 nmol/ml to 6.41 nmol/ml. The decrease in malondialdehyde in the intervention group with the administration of Diplazium esculentum has the potential to reduce MDA levels by increasing the dose to be given.

This study is in line with research conducted by administering methanol extract of Moringa (Moringa oleiferacell cultures of trabecular patients with primary congenital glaucoma and to determine differences in MDA levels in cell cultures exposed to methanol extract of Moringa leaves. with those who did not get any exposure, Based on the one-way ANOVA test, there was a significant difference in MDA levels in the trabecular cell culture of the control and the treatment group at doses of 5 g/ml, 15 g/ml, and 25 g/ml with a significance value of 0.000 ($p<0.05$).

MDA levels in pesticide-using vegetable farmers did not decrease drastically because it was caused by smoking behavior factors, the number of farmers who smoked in the control group was 12 people while in the intervention group was 16 people, this is in line with research conducted by Abdalla in 2013. smoking farmers, malondialdehyde (MDA) levels in the group using chemical pesticides were higher than the group using organic pesticides.observational analytical study with a cross sectional was conducted in the use of chemical pesticides and organic pesticides on farmers to increase levels of (MDA), where levels of malondialdehyde showed a significant difference in plasma malondialdehyde (MDA) levels in farmers who using chemical pesticides is higher than farmers who use organic pesticides.

Comparative study of herbicide pesticides using a combination of the use of glyphosate pesticides with 2,4-dichlorophenoxyacetic acid and a combination of glyphosate with paraquat which examined urine on 62 farmers using thiobarbiturate reactive substances and glutathione (GSH) levels using the enzymatic recycling method. Both combinations of pesticides (glyphosate with 2,4-dichlorophenoxyacetic acid and combination of glyphosate with paraquat) each affected the increase in urine MDA levels. The combination of glyphosate and parquat increased urine MDA levels higher than the combination of glyphosate with 2,4-dichlorophenoxyacetic acid [28].

In vivo study on male mice (Mus musculus) by giving gepok bananas (Musa acuminate) orally in reducing malondialdehyde (MDA) levels in mice exposed to cigarette smoke. Lung MDA was examined using the TBA (thiobarbituric acid) method and data analysis using. 26 male mice (Mus musculus) were divided into 6 groups, and given therapy for 14 days. Kepok banana extract has been shown to reduce malondialdehyde in the lungs of mice because of its potential as an antioxidant [29]. Research Junejo et al. (2018) where

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it is said that an increase in LPO (Lipid Peroxidization) can cause an increase in MDA which is formed as a by-product of LPO. LPO causes antioxidants to decrease so it needs to be increased by giving Diplazium disculentum which acts as an exogenous antioxidant.

CONCLUSION

There is an effect of giving Diplazium esculentum to increase cholinesterase activity and increasing levels of Paraoxonase-1 (PON1), there is no effect of giving Diplazium esculentum to decreasing levels of Malondialdehyde (MDA) in farmers using pesticides in Kanreapia Village, Tombolopao District, Gowa Regency.

SUGGESTION

It is expected that vegetable farmers who use pesticides, especially all respondents, will be able to apply proper pesticide management including the use of PPE, spraying techniques and personal hygiene and health workers to conduct health education about pesticide management in accordance with the correct procedures and the impact on the use of pesticides. Further research is recommended to increase the dose to be given to farmers so that the results of the study are maximized.

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