

## Efek Insektisida Golongan Karbamat Dengan Bahan Aktif Karbofuran Terhadap Kadar Glukosa Pada Tikus Putih (*Rattus norvegicus*) Wistar

### *Effects of Carbamate Insecticides using Carbofuran Active Ingredients on Blood Glucose Levels of Wistar White Rats (*Rattus norvegicus*)*

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#### INTISARI

Karbofuran merupakan insektisida golongan karbamat spektrum luas yang membunuh serangga, tungau, dan nematoda pada secara kontak maupun setelah terkonsumsi. Penggunaan insektisida yang sesuai aturan dapat memberikan keuntungan bagi petani, tetapi bila tidak sesuai, akan menimbulkan kerugian seperti keracunan, gangguan kesehatan, pencemaran lingkungan dan residu pada produk pangan. Jika terpapar, maka akan menyebabkan gangguan kesehatan yang ditandai kenaikan kadar glukosa darah. Penelitian bertujuan untuk mengetahui pengaruh insektisida golongan karbamat dengan bahan aktif karbofuran terhadap kadar glukosa darah pada tikus (*Rattus norvegicus*) Wistar. Penelitian ini menggunakan hewan uji tikus galur Wistar jantan. Penelitian terdiri dari 3 kelompok perlakuan dan 1 kelompok kontrol negatif. Kelompok perlakuan 1 dengan dosis 0,5mg/kgBB tikus, kelompok perlakuan 2 dengan dosis 1,0mg/kgBB tikus, kelompok perlakuan 3 dengan dosis 1,5mg/kgBB tikus, dan kelompok kontrol negatif dengan akuades. Perlakuan dilakukan selama 28 hari, kemudian setiap minggu dilakukan pemeriksaan kadar glukosa darah menggunakan Clinical Chemistry Analyzer konelab 20. Data dideskripsikan dalam bentuk tabel, gambar, dan analisa statistik dengan SPSS 26.

Hasil penelitian ini didapatkan rerata kadar glukosa darah tiap minggu dari minggu ke-0 hingga minggu ke- 4 pada kelompok K1 (76,00; 71,00; 74,60; 75,60; 76,80 mg/dL), P1 (90,40; 91,60; 89,80; 84,80; 67,20 mg/dL), P2 (72,75; 85,00; 88,50; 58,50; 68,25 mg/dL), dan P3 (82,75; 93,00; 100,25; 106,50; 117,75 mg/dL). Analisis data dengan Uji One Way ANOVA nilai  $p=0,035$  ( $p<0,05$ ), terdapat perbedaan kadar glukosa darah yang bermakna pada kelompok perlakuan 3. Kesimpulan pada penelitian ini adalah ada pengaruh karbofuran terhadap kadar glukosa darah tikus pada kelompok perlakuan 3.

Kata Kunci: insektisida, karbofuran, *Rattus norvegicus*, glukosa darah



### ABSTRACT

Carbofuran is carbamate pesticides that kills insects, mites, and nematodes on contact or after consumption. The use of pesticides according to the rules is beneficial for farmers unless it can cause poison, health problems, environmental pollution, and residues in food products. If exposed, it causes health problems characterized by an increase in blood glucose levels. This study aims to identify the effect of carbamate insecticides using active ingredients of carbofuran on blood glucose levels of white Wistar (*Rattus norvegicus*) rats.

This study used male Wistar strain rats. It included 3 treatment groups and 1 negative control group. Treatment group 1 used a dose of 0.5mg/kgBW rats; treatment group 2 used a dose of 1.0mg/kgBW rats; treatment group 3 used a dose of 1.5mg/kgBW rats; and control group used distilled water. The treatment was for 28 days. The blood glucose levels were checked using the Konelab 20 Clinical Chemistry Analyzer per week. Data were presented in tables, figures, and statistical analysis with SPSS 26.

The results of showed the average blood glucose levels from week 0 to week 4 in group K1 (76.00; 71.00; 74.60; 75.60; 76.80 mg/dL), P1 (90.40; 91.60; 89.80; 84.80; 67.20 mg/dL), P2 (72.75; 85.00; 88.50; 58.50; 68.25 mg/dL), and P3 (82.75; 93.00; 100.25; 106.50; 117.75 mg/dL). Data analysis used the One Way ANOVA test with p-values of 0.035 ( $p < 0.05$ ) indicating significant differences in blood glucose levels in treatment group 3. It can be concluded that carbofuran affects blood glucose levels of rats in treatment group 3.

Keywords: insecticide, karbofuran, *Rattus norvegicus*, blood glucose

### INTRODUCTION

*Diabetes mellitus* is dangerous and deadly human disease. According to the Ministry of Health (2014), Diabetes is one of the three main causes of death in Indonesia, accounting for 6.7% of all deaths. This was followed by stroke and coronary heart disease. The prevalence of diabetes in Indonesia increased from 5.7% to 6.9% within 6 years from 2007 to 2013 with 9.1 million people. *Diabetes mellitus* it can be known that it is caused by heredity or lifestyle, but it turns out that diabetes mellitus can also be caused by toxic materials, one of which is pesticides (Suhartono *et al.*, 2018 referred to in Johnson, 1998).

Pesticides are chemical compounds used to eradicate pests, such as insecticides, fungicides, rodenticides, herbicides, acaricides, and bactericides (Raini, 2009). Short-term light exposure causes irritation, while long-term light exposure can cause health effects such as hormonal disturbances and malignancies. Insecticide-type pesticides with organophosphate and carbamate groups are often associated with acetylcholinesterase enzymes, but it turns out that the compounds contained in pesticides are also chemicals that are classified as endocrine disruptors (EDCs), a compound that disrupts the endocrine system which can interfere with hormones in the body, one of which can interfere metabolism that can interfere with carbohydrate metabolism including the formation and breakdown of glucose (Diamanti-kandarakis *et al.*, 2009);(Suhartono, 2014);(Suhartono *et al.*, 2018).

Data on the use of pesticides in Central Java shows that there is still a lot of use of pesticides containing active ingredients whose distribution is prohibited by the UTZ Standards and Certification Department.,one of them is the carbamate class of insecticides with the active ingredient carbofuran which is highly toxic, may have carcinogenic, mutagenic and reproductive toxic effects and can affect the endocrine system (Oktaviani & Pajuang, 2020). Excessive insecticide residues will have an impact on human health if you continue to consume crops that contain residues of these pesticides. Pesticides can be absorbed by plant tissues because of their systemic nature. Pesticides can be toxic to staple crops. It is possible that herbivores or humans may also be eaten, even though carbofuran insecticide is included in systemic pesticides (Hartini, 2014).

The objectives to be achieved in this study were: to determine the effect of carbamate insecticides with the active ingredient carbofuran on blood glucose levels in Wistar rats (*Rattus*

*norvegicus*). The benefits of this study are: The results of this study are expected to provide information to the public, especially farmers, regarding the effect of carbamate class insecticides by active ingredient carbofuran on blood glucose levels. The results of this study are expected to become one of the references in toxicological research. The results of this study can provide basic data that can be used for further research, especially regarding carbamate insecticides.

Based on the theoretical review mentioned above, a hypothesis can be taken, namely that there is an effect of carbamate insecticides with the active ingredient carbofuran on blood glucose levels in rats (*Rattus norvegicus*) Wistar.

## MATERIAL AND METHODS

### Materials and Equipment

The tools used in this study were plastic tubs, wire covers, food containers, drinking bottles, labels, 1 ml gastric tube, beaker glass, handsocon, masks, analytical scales, stationery, hematocrit, red vacuum tube, centrifuge (eppendorf centrifuge 5702), micropipette with tip, and Clinical Chemistry Analyzers (Konlab 20). The materials in this study were the pesticide brand Furadan which contained carbamate class insecticides with the active ingredient carbofuran 3%, and distilled water.

### Ethics Statement

The first step that needs to be done is writing a letterethical clearance so that the research conducted is feasible and safe for researchers and experimental animals. Mice were first acclimatized for 7 days in the Biology Laboratory, Faculty of Mathematics and Natural Sciences, Sebelas Maret University Surakarta so that rats can adapt to a new environment.

### Study population and design

The population in this study were white rats (*Rattus norvegicus*) Wistar. The sample is part of the population. The sample used was male Wistar white rats (*Rattus norvegicus*) kept in the Biology Laboratory, Faculty of Mathematics and Natural Sciences, Sebelas Maret University Surakarta which were given aquadest in the negative control group and given carbofuran in the treatment group, aged 2-3 months, and body weight 150- 250 grams. This research was conducted at the Biology Laboratory, Faculty of Mathematics and Natural Sciences, Sebelas Maret University Surakarta from March to May 2022. The research was carried out based on experimental research by giving direct treatment to rats. Treatment was given for 28 days in the negative control group and the treatment group with graded doses. The treatment group was divided into 3, namely treatment group 1, treatment group 2, and treatment group 3. The rats in each group were then measured for glucose levels every week.

### Measurements and derived traits

Blood glucose measurement was started after acclimatization and after treatment every week for 28 days. Before blood samples were taken, the rats were fasted for 12 hours. Taking Blood was collected in the retroorbital sinus using a hematocrit tube. Blood is collected in vacutainer tubes without anticoagulants. The blood was then allowed to stand until it coagulated and centrifuged at 3000 rpm for 5 minutes. Serum was taken for blood glucose measurement. The serum was separated from the blood cells and put into a sample cup using a 200  $\mu$ L micropipette. Glucose is measured using Clinical Chemistry Analyzers Konlab 20.

The data collection technique in this study was data obtained from the results of measuring blood glucose levels for each rat every week for 28 days which were collected and presented in tabular form. The glucose level data obtained is averaged, then presented in the form of tables and graphs.

Blood glucose levels in rats were processed using the SPSS test Shapiro wilk to determine the normality of the data and test Levene's test to determine the homogeneity of the data. Data is processed using One Way ANOVA, proceed with the test post hoc to determine significant differences between variables.

## RESULT AND DISCUSSION

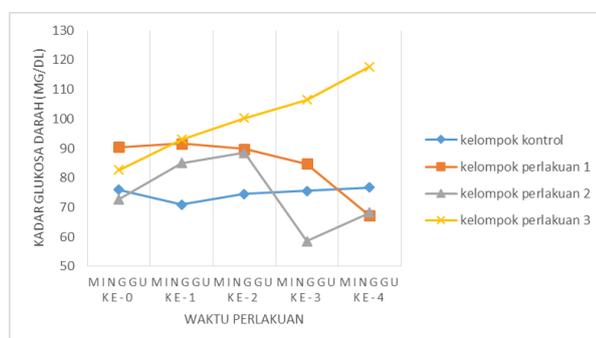
The insecticides used in this study were carbamate class insecticides with the active ingredient carbofuran. The carbofuran used is in the form of purple granules with the trademark Furadan presented in Figure 1.



**Figure 1.** Furadan

The test was carried out using 20 male Wistar rats weighing 150-250 grams which were divided into 4 groups. The test animals were treated according to their group, namely group K1 which was the negative control, group P1, P2, P3 as the test group with graded doses. The carbofuran solution for the treatment group was prepared by weighing the carbofuran brand Furadan according to the dose of each rat. Treatment group 1 with a dose of 0.5 mg/kgBB; treatment group 2 with a dose of 1.0 mg/kgBB; and treatment group 3 with a dose of 1.5 mg/kgBB. The substance that has been weighed is then dissolved with distilled water up to 1 mL, then shaken until homogeneous. For the negative control group given distilled water. The finished solution was administered orally to each rat using a gastric tube.

The test animals were acclimatized for 7 day before testing. Measurement of blood glucose levels was also carried out before treatment. The rats were fasted before their blood was drawn. The control group was given distilled water. In group P1, the treatment group 1 was given carbofuran using a sonde at a dose of 0.5 mg/kg, in group P2, namely the 2nd treatment group was given carbofuran using a sonde at a dose of 1.0 mg/kg, the P3 group, namely the 3rd treatment group, was given carbofuran using a sonde at a dose admission is given every 3 every week is done h through retro-sine blood count is done keep it for 8-12 hours. a glucose test anClinical Chemistry glucose check n weekly and for the table. measurement mice each Table 1 and content chart Blood glucose is shown in Figure 2. Table 1 shows the average for each treatment group from week 0 to week 4.



**Figure 2.** Graph of average blood glucose levels in the control group, treatment group 1, treatment group 2 and treatment group 3

The research data obtained was tested first use the test Shapiro Wilk to see the distribution of data. Data normally distributed if significant  $>0.05$ . Results that are normally distributed can be continued to the next test, the next test is the homogeneity test. Test Levene Test used for

homogeneity. If the significance is  $> 0.05$ , then the data is homogeneous. Homogeneous data can be continued to the ANOVA test. If the significance (Sig)  $< 0.05$ , then the data can be continued to the test Post Hoc.

**Table 1.** Mean Results of Measuring Blood Glucose Levels in White Rats Before and After Treatment

Kelompok Perlakuan	Kadar glukosa darah mg/dL (Mean±SD)				
	Minggu ke- 0	Minggu ke- 1	Minggu ke- 2	Minggu ke- 3	Minggu ke- 4
K1	76,00±11,49	71,00±5,80	74,60±7,70	75,60±9,45	76,80±8,08
P1	90,40±13,83	91,60±16,35	89,80±24,89	84,80±24,60	67,20±35,97
P2	72,75±13,30	85,00±14,31	88,50±52,36	58,50±13,82	68,25±13,45
P3	82,75±12,23	93,00±14,35	100,25±16,05	106,50±15,29	117,75±13,60

Information:

K1: Control group (aquades)

P1: Treatment group 1 (carbofuran dose of 0.5 mg/kg BW)

P2: Treatment group 2 (carbofuran dose of 1.0 mg/kg BW)

P3: Treatment group 3 (carbofuran dose of 1.5 mg/kg BW)

The results of the statistical analysis of the one way ANOVA test on the average blood glucose levels for all groups shown in Table 2 show that the data are normally distributed ( $p > 0.05$ ) and homogeneous ( $p > 0.05$ ). The one way ANOVA test in Table 4 with the results of  $p = 0.035$  ( $p < 0.05$ ) showed that the mean blood glucose levels in the treatment group 3 (P3) were significantly different, rejecting  $H_0$ . The results of this study are in line with Astari & Dangiran's research in 2019, research showing that there is a relationship between the frequency of using pesticides and blood sugar levels. This is also in accordance with a literature review which states that farmers are at higher risk of developing diabetes because they use pesticides that can increase blood sugar levels (Fandana, 2020).

**Table 2.** One Way ANOVA Test Results

Variabel	N	Nilai p
Kelompok kontrol negatif	5	0,908
Kelompok perlakuan 1	5	0,501
Kelompok perlakuan 2	4	0,507
Kelompok perlakuan 3	4	0,035

Test Post Hoc carried out next to see which groups have differences in treatment group 3. Test results Post Hoc showed that there was a difference between the levels before treatment and the levels after treatment weeks 3 and 4. The results at weeks 3 and 4 had the same effect in increasing blood glucose levels. Results in weeks 1 and 2 did not show significant results. Based on the test,  $H_a$  is accepted and  $H_0$  was rejected, so it can be said that there was an effect of giving carbofuran on blood glucose levels, which increased at the highest dose.

Carbamate pesticides are relatively more easily decomposed by the environment, so residues can be left on plants. The use of carbamates has also been shown to influence incidence diabetes mellitus (Sari *et al.*, 2021). Exposure pesticide excessive could causes disruption of glucose metabolism in the body, thus causing the body to experience impaired insulin resistance which can lead to disease diabetes mellitus (Sari *et al.*, 2021). The results showed that blood glucose levels in rats had increased but were still at the normal threshold of 30-135 mg/dL (Colby & Nowland, 2019). This means that there are no levels that exceed normal limits, but there are results that show high levels at week 4 in treatment group 3 (can be seen in Appendix 6). This is in accordance with what was described by Papovska *et al.* in a survey conducted in 2014. In this study, animal studies were

carried out and showed that carbaryl insecticides (carbamate group) affect the balance of glucose and insulin secretion in animals.

Rate which got almost close to the normal threshold value. This could be a potential occurrence diabetes mellitus in the chronic term. Diabetes mellitus which is a disorder of glucose metabolism characterized by decreased insulin secretion by pancreatic cells and increased blood glucose levels due to impaired insulin function (insulin resistance). Pancreatic beta cells do not function optimally, resulting in poor insulin secretion and high blood sugar levels (Fatimah, 2015)

## CONCLUSION

Based on the results of the study it can be concluded that there was an effect of carbamate class insecticides, the active ingredient carbofuran, namely an increase in blood glucose in rats before treatment and after treatment in treatment group 3.

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