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Memory Activity Test Of Ethanol Extract Of Oil Palm Leaves (Elaeis Guineensis Jacq.) On White Mice (Mus Musculus) With Radial Arm Maze Method

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Abstract

Memory loss is a cognitive disorder in which oxidative stress is one of the main contributing factors. Palm leaves oil (Elaeis guineensis Jacq.) contains flavonoids and antioxidants that are believed to improve memory. This study aims to determine whether oil palm leaf extract can improve memory activity in mice and determine the most effective dosage. This study was a pure experimental study with 25 mice divided into five groups, namely negative control (CMC Na 1%), positive control (Ginkgo biloba), and treatment groups with ethanol extracts of oil palm leaves at doses of 100 mg/kgBW, 200 mg/kgBW, and 300 mg/kgBW. The mice were induced with 10% alcohol and then given treatment for 7 days. Memory activity was tested using the Radial Arm Maze method, with parameters measured including latency time and error rate. The data obtained were then analyzed using SPSS, including normality and homogeneity tests, Anova, and followed by the Tukey test. The results showed that doses of palm leaf extract (Elaeis guineensis jacq.) of 100 mg/kgBW, 200 mg/kgBW, and 300 mg/kgBW had an effect on the memory of mice. The effective dose for improving memory in the T1-T2 latency time difference was 200 mg/kgBW and 300 mg/kgBW with a P value > 0.05, which was not significantly different from the positive control, and the T1-T2 error rate difference was 100 mg/kgBW, 200 mg/kgBW, and 300 mg/kgBW, with a P value > 0.05, showing no significant difference from the positive controls. This proves that oil palm leaf extract can enhance memory activity in mice.

Keywords: Flavonoids, Memory, Oil Palm Leaves, Radial Arm Maze.

INTRODUCTION

Memory or recall is something that is very important for humans, this is because of the power of the human soul in receiving, storing, processing and reproducing impressions and responses.(Putri et al., 2025). A person's memory declines with age, but it can also occur at a young age. Memory loss can lead to a decline in thinking skills, including the ability to recall and store memories, making it difficult for patients to carry out daily activities (Ardiyantoro et al., 2025).

Oxidative stress results from excessive damage caused by free radicals. An increase in free radicals in the body leads to increased oxidative stress, which over time can reduce enzymatic activity and impair memory. Antioxidants are essential to counteract the effects of free radicals (Oktavia et al., 2025).

Research (Tewari et al., 2023) explains that the use of non-natural, semi-synthetic, or synthetic drugs, such as haloperidol, risperidone, and olanzapine, to treat dementia, remains controversial. These drugs are used to treat dementia, but they affect some symptoms at various stages of the disease, but they cannot halt the progressive course of the disease.

Oil palm leaves (Elaeis guineensis Jacq.) are a plant rich in natural antioxidants. Bioactive compounds found in oil palm leaves include alkaloids, phenolic compounds, saponins, flavonoids, triterpenoids, and tannins (Patimah et al., 2023). Flavonoids, one of the compounds found in oil palm leaves, act as antioxidants, scavenging free radicals in the body, one of which is protecting against free radicals that can damage brain cells. Flavonoids can also work by protecting against oxidative stress (Simanjuntak, 2020). Their antioxidant content can help prevent neurodegenerative disorders that cause cognitive decline and memory loss (Wael, 2022).

Dementia is the most common disease associated with impaired cognitive function. In the elderly, dementia has a high incidence and progresses rapidly and severely. According to international data, there are an estimated 1.2 million people with dementia in Indonesia, making it one of the ten countries with the highest dementia rates in the world and in Southeast Asia (Rahmawati et al., 2024).

Research (Faridho & Cahyo, 2025) also states that the prevalence of dementia is higher than the national rate in Indonesia, which is 27.9%.

Dementia is a cognitive impairment that slowly but progressively worsens (Ratnawati, 2021). Dementia is a disorder that affects the brain. People with dementia experience impaired intellectual function, which disrupts daily activities and relationships with others. They lose the ability to solve problems and control their emotions, and may experience personality changes and behavioral problems, such as irritability and hallucinations (Abdillah, 2020).

Previous research conducted by (Putri et al., 2025) Testing the Activity of Clove Leaf Extract (Syzygium aromaticum) on White Mice (Mus Musculus) Using the Radial Arm Maze Method showed the potential of clove leaf extract as a natural alternative to improve memory, especially in the context of neurodegenerative diseases such as Alzheimer's. Therefore, researchers are interested in conducting research on memory data activity tests on mice using different plants and different doses to see whether oil palm leaf plants have memory activity and determine at what dose is effective in improving memory activity.

Based on the description above, oil palm leaf extract (Elaeis guineenis Jacq.) shows promising potential in improving memory activity. Oil palm leaves contain active compounds, one of which is flavonoids which are known to have neuroprotective effects and can modulate brain function, including improving memory (Temesgen et al., 2022). The method used in this study is the Radial Arm Maze method which can determine memory scores in mice by measuring memory scores against the frequency of mice entering the arms correctly or incorrectly. The Radial Arm Maze task is to see the memory ability of mice, in remembering the location of objects.

RESEARCH METHODS

Types and Methods of Research

This study is a pure experimental study with 25 mice divided into five groups, namely negative control (CMC Na 1%), positive control (Ginkgo biloba), and treatment group of oil palm leaf ethanol extract with doses of 100 mg/kgBW, 200 mg/kgBW, and 300 mg/kgBW. Mice were induced with 10% alcohol after which they were given treatment for 7 days. Memory activity was tested using the Radial Arm Maze method, the parameters measured included latency time and error rate. The data obtained were then analyzed using SPSS including normality test, homogeneity, ANOVA and continued with Tukey test.

The test method used was the Radial Arm Maze method, which measures the memory score based on the frequency of mice entering the arms correctly or incorrectly. Mice are said to have high memory if the frequency of correctly entering the arms is greater than the frequency of incorrectly entering the platform. The higher the mouse's memory, the higher its memory score (Heroweti).*et al.,*(2019)

Data Analysis Instruments and Techniques

The tools used in this study were a sonde syringe (onemed®), maceration container, 40 mesh sieve, water bath, dropper pipette, porcelain cup, mortar stamfer, stirring rod, rotary evaporator, stopwatch, scale (Fujitsu®), chamber, tweezers, wooden clamp, capillary tube, oven binder, test tube (Iwaki®), test tube rack, beaker glass, porcelain crucible, electric stove, Radial Arm Maze test tool. Other materials were oil palm leaf extract (Elaeis guineensis Jacq.), 70% ethanol, 10% alcohol, 1% CMC Na, ginkgo biloba powder obtained from Sido Muncul ginkgo biloba capsules 60 mg (Ahmad, 2023).

Research Procedures

Ethical Clearance

Ethical Clearance or a certificate of ethical feasibility as a requirement in research using test animals was obtained from the health research ethics commission of Dr. Moewardi Regional Hospital on Jl. Kolonel Sutarto No. 132, Jebres Village, Jebres District, Surakarta City, Central Java.

Determination

Determination was conducted at the Biology Laboratory of the Faculty of Mathematics and Natural Sciences, Tanjungpura, Pontianak. Based on the results of the determination, the plant used in this study was indeed an oil palm leaf (Elaeis guineensis jacq.).

Material Sourcing

Oil palm leaf samples were obtained from an oil palm plantation on Jl. Parit Berkat, Punggur Besar Village, Sungai Kakap District, Kubu Raya Regency, West Kalimantan Province. The samples used in this study were fresh, green leaves in good condition, fresh, and not rotten.

Making Simple Oil Palm Leaves (Elaeis guineensis jacq.)

Oil palm leaves are wet sorted and separated into leaves and stems. They are then washed thoroughly under running water, shredded, and cut into small pieces. They are then dried in a dry cabinet at 40°C. After dry sorting, the crude drug is ground using a blender and sieved through a 40-mesh sieve (Fauzi et al., 2023).

Standardization of Oil Palm Leaf Simplicia (Elaeis guineensis jacq.)

Drying Shrinkage of Simple Drugs

Measurements were made by weighing 2 grams of the drug, then placing it in an empty container and measuring the drying loss using an oven at 105°C. The drug powder can be said to meet the requirements if the drying loss shows a level of no more than 10% (Ministry of Health of the Republic of Indonesia, 2022).

Determination of Water Content of Simple Drugs

The moisture balance instrument is first turned on and the needle is at zero and indicates neutral. Next, 2 grams of the herbicide is placed on the parchment and the weights are leveled until the needle is centered. The light is turned on and the temperature is set to 100°C. Measurements are taken until the red needle moves to the right and stops moving, after which the light is turned off. The measuring knob is turned to the left until it returns to its original position, and the moisture content is read. The moisture content requirement is less than 10% (Ministry of Health of the Republic of Indonesia, 2022).

Determination of Ash Content of Simple Drugs

Ash content can be determined by weighing 2 grams of the crude palm leaf, placing it in an empty, pre-treated furnace, and heating it in a furnace at a temperature gradually increased to 600°C. Afterward, it is cooled in a desiccator and weighed. The ash content of crude palm leaf crude palm leaf is no more than 10% (Ministry of Health of the Republic of Indonesia, 2022).

Preparation of Oil Palm Leaf Extract (Elaeis guineensis jacq.)

Oil palm leaf extraction was carried out using a room temperature maceration method with 70% ethanol as a solvent (Fauzi et al., 2023). The ratio used was 1:10 of the crude drug and solvent. The maceration was carried out for 3 x 24 hours with occasional stirring. After that, the filtrate from the maceration results was filtered using Büchner filter paper and vacuum, then concentrated with a rotary evaporator at 60°C to obtain a thick extract (Indrisari et al., 2023).

Standardization of Oil Palm Leaf Extract (Elaeis guineensis jacq.)

Extract Drying Loss

The extract was weighed as much as 2 grams, then put into an empty exchanger and heated using an oven at a temperature of 1050C with the lid open and then dried at the specified temperature until the weight was constant. (Ministry of Health of the Republic of Indonesia, 2022) the percentage of drying loss of oil palm leaf extract showed no more than 10%.

Determination of Water Content of Extract

Determination of water content is done by weighing 2 grams of extract using a cup, then the moisture balance is set to 1050C. The moisture balance is closed and wait for a few minutes to record the results of the water content that appears on the moisture balance, the standard measurement of water content of oil palm leaf extract is no more than 10% (Ministry of Health of the Republic of Indonesia, 2022).

Determination of Ash Content of Extract

Determination of ash content is carried out by weighing 2 grams of simplicia, which is put into a tared silicate crucible, heated in a furnace at a temperature that is gradually increased to 6000 C. After that, it is cooled in a desiccator and then weighed. The total ash content is calculated against the weight of the test material and expressed in % w/w (Fatmawati, 2019). The total ash content of oil palm leaf simplicia is not more than 10% (Silverman et al., 2023).

Ethanol Free Check

The ethanol-free test for oil palm leaves can be performed by adding H2SO4 and CH3COOH solutions to the extract, then heating it. Ethanol-free is indicated by the absence of a distinctive ethanol odor (Kurniawati Evi, 2025).

Phytochemical Screening

Identification of Alkaloids

Oil palm leaf extract was placed in a test tube, then 3 mL of 2% HCl was added, heated and shaken until dissolved, then filtered. The filtrate was placed in three test tubes. Two to three drops of Mayer's reagent, Dragendorff's reagent, and Wagner's reagent were added to each tube. The presence of alkaloids is indicated by the formation of a white precipitate in Mayer's reagent, an orange or red precipitate in Dragendorff's reagent, and a reddish-brown or brown precipitate in Wagner's reagent (Budikania et al., 2023).

Flavonoid Identification

Then, 0.5 grams of thick oil palm leaf extract was placed in a test tube and 10 ml of distilled water was added. A total of 5 ml of filtrate was taken and reagents were added. Two solvents were used: 0.1 g of Mg powder and 1 ml of concentrated HCl. A yellow color indicated the presence of flavonoids (Ahmad et al., 2020).

Tannin Identification

A 0.5 gram thick extract of oil palm leaves was added to 10 ml of distilled water. A 2 ml filtrate was placed in a test tube and 1 to 2 drops of iron(III) chloride reagent were added. A dark blue or blackish-green color indicates the presence of tannins (Ahmad et al., 2020).

Saponin Identification

A 0.5 gram thick extract of oil palm leaves was added to distilled water and then shaken vigorously. A positive saponin test result was confirmed if a permanent foam formed within 10 minutes (Ahmad et al., 2020).

Identification of Steroids and Triterpenoids

A 0.5 g thick extract of oil palm leaves was added to 10 ml of distilled water. A 2 ml filtrate was placed in a tube and dissolved in 0.5 ml of chloroform, then 0.5 ml of anhydrous acetic acid and 2 ml of concentrated sulfuric acid. The extract was said to contain steroids if it formed a blue or green color, while the extract was said to contain triterpenoids if it produced a purple color (Ahmad et al., 2020).

Grouping of Test Animal Treatments

In this study, 25 male mice were used with 5 test groups consisting of negative controls, positive controls, and treatment groups with three doses of extract (Ahmad, 2023).

Group I : Mice in the positive control group were given 60 mg of Ginkgo biloba
Group II : Mice in the negative control group were given 1% CMC Na
Group III : Treatment group I was given oil palm leaf extract at a dose of 100 mg/kgBW
Group IV : Treatment group II was given oil palm leaf extract at a dose of 200mg/kgBW
Group V :Treatment group III was given oil palm leaf extract at a dose of 300 mg/kgBW.

Test Procedure

The mice were fasted for 12 hours and acclimatized for 7 days, after which the mice were induced with 10% alcohol orally, induction was carried out from the 7th day after the last parameter of the acclimatization stage until the 14th day, then on the last day the time parameters needed for the mice to find food were measured (Larasati, 2021). After being induced, the mice were given a dose of

extract according to their respective groups, carried out from the 14th day after alcohol induction until the 21st day, then on the last day the time parameters needed for the mice to find food were measured. The method used was the Radial Arm Maze method using 25 male mice divided into 5 test groups (Ahmad, 2023).

Data analysis

Data analysis that will be used for memory test research using the Radial Arm Maze method to obtain the results of the normality test power analysis of latency time on T0, T1, T2 data using the Shapiro-Wilk test. Shows normally distributed data if each group has a P value (Sig.) > 0.05, then continued with a homogeneity test showing homogeneous data if it has a significant value (P-value) > 0.05, this is influenced because each group has the same data variation. Subsequent data analysis using the One Way Anova Analysis method and continued with the Post Hoc Test with the Tukey test (HSD) to determine significant differences between one group and another (Andhika et al., 2023).

RESULTS AND DISCUSSION

Ethical Clearance

*Ethical Clearance*or a certificate of ethical feasibility as a requirement in research using test animals is obtained from the health research ethics commission of Dr. Moewardi Regional Hospital on Jl. Kolonel Sutarto No. 132, Jebres Village, Jebres District, Surakarta City, Central Java.

Plant Determination

The plants used in this study were oil palm leaves collected from an oil palm plantation on Jl. Parit Berkat, Punggur Besar, Sungai Kakap District, Kubu Raya Regency. Determination was performed using small, intact plants. The purpose of plant identification was to clearly identify the plants under study and to avoid errors in collecting primary research materials.

The determination was conducted at the Biology Laboratory of the Faculty of Mathematics and Natural Sciences, Tanjungpura, Pontianak. Based on the results, the plant used in this study was indeed an oil palm leaf (Elaeis guineensis jacq.).

Making Palm Oil Leaf Simple Powder

Table1. Calculation of Palm Oil Leaf Simple Yield

Wet Weight	Weight of Dry Simplicia	Yield
5.205 grams	920 grams	17%

The yield of crude palm leaf simplicia was 17%, which meets the requirements for crude palm leaf simplicia yield, which is more than 10%. The higher the crude palm leaf simplicia yield, the higher the compound content obtained. If the yield is less than 10%, this indicates that the extraction process is less efficient or the quality of the leaves used is poor, resulting in fewer active compounds. Calculation of crude palm leaf simplicia powder yield aims to determine the percentage of crude palm leaf simplicia powder yield resulting from various processing processes (Susetyarini et al., 2022). Based on the crude palm leaf simplicia yield obtained from weighing, the wet weight of crude palm leaves is 5,205 grams and the dry weight is 920 grams. From these data, a percentage of 17% was obtained.

Standardization of Simple Drugs

Drying Shrinkage of Simple Drugs

Table2. Drying Shrinkage of Simple Drugs

Replication	Weight of empty crucible (g)	Crucible + sample weight before oven (g)	Crucible + sample weight after oven (g)	Drying loss (%)	Average (%)
1	43,042	45,042	44,612	0.95	
2	43,064	45,064	44,614	0.99	0.97
3	43,049	45,049	44,609	0.97	

The drying shrinkage of oil palm leaf simplicia (Elaeis guineensis jacq.) was carried out using an oven with 3 replications at a temperature of 1050C for 30 minutes until a constant weight was achieved, which was stated as a constant value. The drying shrinkage of oil palm leaf simplicia obtained a drying shrinkage value of 0.97%, so it has met the requirements of no more than 10%.

Water Content of Simple Drugs

The water content test of oil palm leaf simplicia (Elaeis guineensis jacq.) was conducted to determine the percentage of water content in the simplicia, the water content examination was carried out using a moisture balance. The results of the determination of the water content of oil palm leaf simplicia powder were 8.6%, this indicates that the oil palm leaf simplicia has met the requirements of less than 10%.

Table3. Water Content of Simple Drugs

Replication	Powder Weight (g)	Water content of simple drug (%)	Average (%)
1	2	8.90	
2	2	9.00	8.6
3	2	8.10	

Ash Content of Simple Drugs

Determination of ash content can be done by weighing 2 grams of simplicia, then put into an empty exchanger that has been through the calibration process, then heated in a furnace with a temperature gradually increased to 6000 C. After that, it is cooled in a desiccator and then weighed. The results of the ash content test of oil palm leaf simplicia are 2.15% so that it has met the specified requirements, namely less than 10%.

Table 4. Ash Content of Simple Drugs

Replication	Weight of empty crucible (g)	Simple Weight (g)	Weight of ash + crucible after heating (g)	Ash content of simple drug (%)	Average (%)
1	44,609	2	44,650	2.05	
2	44,607	2	44,652	2.25	2.15
3	44,610	2	44,653	2.15	

Making Oil Palm Leaf Extract

The preparation of oil palm leaf extract (Elaeis guineensis jacq.) was carried out using the maceration and remaceration method for 5 days using 70% ethanol solvent. The macerate obtained from the maceration and remaceration was filtered using a Buchner apparatus, then evaporated using a rotary evaporator and then thickened using a water bath to obtain a thick extract. The thick extract obtained was weighed and calculated. The results of the powder weight of 495.3 grams obtained a thick extract weight of 65.5 grams with a yield of 13.2%. So it has met the good requirements of not less than <10%.

Table 4.Results of Palm Oil Leaf Extract Yield

Powder weight	Extract weight	Yield
495.3 grams	65.5 grams	13.2%

Extract Standardization

Extract Drying Loss

The drying shrinkage of oil palm leaf extract (Elaeis guineensis jacq.) was carried out using an oven and replicated 3 times, at a temperature of 1050C for 30 minutes until the weight was stable, which was stated as a constant value. The drying shrinkage of oil palm leaf extract obtained a drying shrinkage value of 0.64%, indicating that it meets the requirements of no more than 10%. The drying shrinkage results of oil palm leaf extract can be seen in table 4.6.

Table5. Results of Drying Shrinkage of Palm Oil Leaf Extract

Replication	Weight of empty crucible (g)	Crucible + sample weight before oven (g)	Crucible + sample weight after oven (g)	Drying Loss (%)	Average (%)
1	46,373	48,373	48,098	0.56	
2	46,291	46,291	48,599	0.63	0.64
3	41,467	43,467	43,148	0.73	

Water content of extract

The water content test of oil palm leaf extract (Elaeis guineensis jacq.) was conducted to determine the percentage of water content in the simplicia, the water content examination was carried out using a moisture

balance. The results of the determination of the water content of oil palm leaf extract were 7.04%, this indicates that the oil palm leaf extract has met the requirements of less than 10%.

Table 6. Results of Water Content of Oil Palm Leaf Extract

Replication	Sample weight (g)	Water content %	Average%
1	2	7.84	
2	2	8.30	7.04
3	2	5.25	

Ethanol Free Check

The ethanol-free test is carried out by putting the extract into a test tube, then adding H2SO4 and CH3COOH, then heating it. The condition for ethanol-free is if the characteristic ethanol odor is not detected.

Ash Content of Extract

The ash content was determined by weighing 2 grams of the crude drug, which was placed in a tared silicate crucible, heated in a furnace at a temperature gradually increased to 6000C. After that, it was cooled in a desiccator and then weighed and calculated. Based on the test results, the ash content of oil palm leaves was 8.55%, thus fulfilling the specified criteria of no more than 10%.

Table 7.Results of Ash Content Test of Oil Palm Leaf Extract

Replication	Weight of empty crucible (g)	Sample weight (g)	Weight of crucible + sample after heating (g)	Ash content %	Average (%)
1	43,810	2	43,981	8.55	
2	45,148	2	53,319	8.55	8.55
3	48,978	2	49,149	8.55	

Phytochemical Screening

The phytochemical screening test in tubes includes the examination of alkaloids, flavonoids, tannins, saponins, triterpenoids, and steroids. Identification of chemical compounds, or phytochemical screening, is performed to determine the chemical compounds contained in oil palm leaf extract. Based on the phytochemical test results, the oil palm leaf extract tested positive for alkaloids, flavonoids, tannins, saponins, triterpenoids, and steroids.

Table 8. Phytochemical Screening Test Results

Compound	Reagent	Results	Result description	Reference results (Asfahani et al., 2022)
Alkaloid	Mayer	+	White precipitate forms	White precipitate forms
	Wagner	+	A brown precipitate forms	Brown sediment forms
	Dragendorf	+	Orange sediment formed	There is a brownish orange precipitate
Flavonoid	H2SO4 mg powder	+	Yellow or orange color is formed	Reddish orange in color
Tannin	FeCl3	+	Formed green or blue-green color	Blackish green in color
Saponin	Aquadest	+	Formation of stable foam	There is foam
riterpenoid	Chloroform + sulfuric acid	+	Brown color is formed	Brown or purple color
Steroid	Lieberman Burchard (acetic acid-concentrated sulfuric acid)	+	A reddish brown color is formed	Blue, red or green

Memory Test Results

This study used 25 mice divided into 5 treatment groups, each group consisting of 5 mice, with an average weight of approximately 20-30 grams. The Radial Arm Maze method was used. The Radial Arm Maze method produces more qualitative data for observing motor and cognitive activity in the central nervous system. Motor activity was observed from the time it took the mice to follow the arms until they found the pellet in one of the arms, while cognitive activity was observed by the error rate of the mice entering the maze arms until

they found the arm filled with bait. Induced using 10% ethanol. The parameters tested were latency time and error rate (Ahmad, 2023).

Latency Time Observation Results

Latency time observations were carried out by measuring how long it took the mice to find and eat the bait at one end of the arm.

Table9. Latency Time Observation Data Results

Test Group	SD Latency Time (Second)		
	T0	T1	T2
Negative Control (CMC-Na)	83.0±1.00	87.0±1.58	84.0±1.92
Positive control (Gingko biloba)	79.6±1.14	84.8±1.92	64.8±2.86
Palm Oil Leaf Extract Dose 100 mg/kgBW	81.0±1.58	82.8±1.92	70.4±4.04
Palm Oil Leaf Extract Dose 200 mg/kgBW	84.8±0.48	89.2±0.84	69.4±38.5
Palm Oil Leaf Extract Dose 300 mg/kgBW	86.2±0.84	89.6±1.14	67.8±5.93

Information :
T0 : Observation of latency time before treatment
T1 : Observation of latency time after 10% ethanol induction
T2 : Observation of latency time after treatment of the test group

Table 10. Latency Time Difference

Test animal groups	ΔT ± SD
Negative Control (CMC-Na)	3.4 ± 1.14
Positive Control (Gingko biloba)	23 ± 1.58
Palm Oil Leaf Extract Dose 100 mg/kgBW	16 ± 1.58
Palm Oil Leaf Extract Dose 200 mg/kgBW	19 ± 1.36
Palm Oil Leaf Extract Dose 300 mg/kgBW	21.8 ± 2.86

Information :
ΔT : Latency Time Difference T1-T2

Results of Observation of Error Rate

Observation of error rates in this study, namely by calculating how many mice entered the arm that was not baited and entered half of the arm but did not eat the bait.

Table11. Error Number Data Results

Test Group	Error Number		
	T0 %	T1%	T2%
Negative Control (CMC-Na)	28.33±0.65	30.64±0.46	28.24±1.49
Positive control (Gingko biloba)	30.05±0.83	32.64±1.24	24.17±1.39
Palm Oil Leaf Extract Dose 100 mg/kgBW	30.04±1.41	32.34±0.94	28.19±1.49
Palm Oil Leaf Extract Dose 200 mg/kgBW	26.15±1.21	28.27±1.36	26.57±1.24
Palm Oil Leaf Extract Dose 300 mg/kgBW	26.15±1.21	28.19±1.40	24.22±1.47

Information :
T0 : Observation of error rate before treatment
T1 : Observation of error rate after 10% ethanol induction
T2 : Observation of error rate after treatment of test group

Table 12. Difference in Error Numbers

Test animal groups	ΔT ± SD
Negative Control (CMC-Na)	1.63 ± 0.35
Positive Control (Gingko biloba)	7.47 ± 1.33
Palm Oil Leaf Extract Dose 100 mg/kgBW	2.42 ± 0.48
Palm Oil Leaf Extract Dose 200 mg/kgBW	3.07 ± 0.86
Palm Oil Leaf Extract Dose 300 mg/kgBW	4.45 ± 0.22

Information :
ΔT : Difference between T1-T2 Error Numbers

Data Analysis

Latency Time Data Analysis Results

After observing the latency time before treatment (T0), the time after 10% alcohol induction (T1), and the time after treatment for each group (T2), statistical tests were carried out using SPSS, including normality tests, homogeneity tests, ANOVA tests and continued with Post Hoc Tests using Tukey tests which are useful for identifying differences between various test groups. The treatment groups tested statistically were T2 and the difference between T1 and T2.

The statistical test of the T2 latency time in the Normality Test shows that the data is normally distributed so that it can be continued with the Homogeneity Test.

Table13. Results of the Normality Test for Latency Time Memory

	ity Test	
Test Group	**p-value**	**Description**
Negative Control	0.314	
Positive Control	0.680	
100 mg/kgBW	0.424	0.05 indicates that the data is normally distributed, followed by a homogeneity test.
200 mg/kgBW	0.613	
300 mg/kgBW	0.635	

The statistical test of the T2 latency time in the Homogeneity Test shows that the data is homogeneous so it can be continued with the One Way Anova Test.

Table14. Results of the Homogeneity Test of Latency Time Memory

	Homogeneity Test	
Test Group	**p-value**	**Description**
T2	0.317 0.463 0.466 0.331	P > 0.05 indicates that the data is homogeneous, followed by the ANOVA test.

The statistical test of the T2 latency time in the One Way Anova Test shows that there is a significant difference between the treatment groups so that it can be continued with the Tukey Post Hoc Test.

Table15. Test Results*ANOVA of Memory Latency Time*

	ANOVA test	
Test Group	**p-value**	**Description**
T2	0,000	P < 0.05, for significant differences, continued with post hoc test

The statistical test of the T2 latency time in the Post Hoc Test showed that there were significant and non-significant differences between the treatment groups.

Table 16. Test Results*Post Hoc Test of Latency Time Memory*

Test Group	**alue**	**Description**
K- and K+	)00	P < 0.05 There is a difference
K- and dose 100 mg/kgBW	)00	P < 0.05 There is a difference
K- and dose 200 mg/kgBW	)00	P < 0.05 There is a difference
K- and dose 300 mg/kgBW	)00	P < 0.05 There is a difference
K+ and dose 100 mg/kgBW	:70	P > 0.05 There is no difference
K+ and dose 200 mg/kgBW	:54	P > 0.05 There is no difference
K+ and a dose of 300 mg/kgBW	'99	P > 0.05 There is no difference
Dosage 100 mg/kgBW and 200 mg/kgBW	)96	P > 0.05 There is no difference
Dosage 100 mg/kgBW and 300 mg/kgBW	:69	P > 0.05 There is no difference
Dosage 200 mg/kgBW and 300 mg/kgBW	)75	P > 0.05 There is no difference

The statistical test of the difference in latency time T1 -T2 in the Normality Test shows that the data is normally distributed so that it can be continued with the Homogeneity Test.

Table 17. Results of the Normality Test for Latency Time Differences

Normality Test		
Test Group	**p-value**	**Description**
Negative Control	0.814	
Positive Control	0.967	
Extract Dosage 100 mg/kgBW	0.967	P > 0.05 indicates that the data is normally distributed, followed by a homogeneity test.
Extract Dosage 200 mg/kgBW	0.482	
Extract Dosage 300 mg/kgBW	0.823	

The statistical test of the difference in latency time T1 -T2 in the Homogeneity Test shows that the data is homogeneous so that it can be continued with the One Way Anova Test.

Table 18. Homogeneity Test Results of Latency Time Difference

Homogeneity Test		
Test Group	**p-value**	**Information**
ΔT Difference between T1 and T2	0.164 0.391 0.411 0.182	P > 0.05 indicates that the data is homogeneous, followed by the ANOVA test.

The statistical test of the difference in latency time T1 -T2 in the One Way Anova Test shows that there is a significant difference between the treatment groups so that it can be continued with the Tukey Post Hoc Test.

Table 19. Test Results*Anova Latency Time Difference*

ANOVA test		
Test Group	**p-value**	**Information**
ΔT Difference between T1 and T2	0,000	P < 0.05, for significant differences, continued with post hoc test

The statistical test of the difference in latency time T1 -T2 in the Post Hoc Test showed that there were significant differences and no significant differences between the treatment groups.

Table 20. Post Hoc Test Results of Memory Power Latency Time Difference

Hoc Test		
Test Group	**value**	**Description**
K- and K+	,000	5 There is a difference
K- and dose 100 mg/kgBW	,000	5 There is a difference
K- and dose 200 mg/kgBW	,000	5 There is a difference
K- and dose 300 mg/kgBW	,000	5 There is a difference
K+ and dose 100 mg/kgBW	0.001	5 There is a difference
K+ and dose 200 mg/kgBW	0.066	> 0.05 There is no difference
+ and a dose of 300 mg/kgBW	0.909	> 0.05 There is no difference
Dosage 100 mg/kgBW and 200 mg/kgBW	0.241	> 0.05 There is no difference
Dosage 100 mg/kgBW and 300 mg/kgBW	0.004	P < 0.05 There is a difference
Dosage 200 mg/kgBW and 300 mg/kgBW	0.302	0.05 There is no difference

CONCLUSION

This study concluded that the ethanol extract of oil palm leaves Elaeis guineensis Jacq. significantly improved memory activity in white mice Mus musculus induced by 10% alcohol, as evidenced by the Radial Arm Maze method. The main findings showed a significant decrease in latency time and error rate in the treatment groups of 100, 200, and 300 mg/kgBW doses compared to the negative control, with the 200 and 300 mg/kgBW doses being the most effective for the T1-T2 latency difference ($p<0.05$, not different from positive Ginkgo biloba), and all doses were effective for the T1-T2 error rate difference. Phytochemical screening confirmed the content of flavonoids, alkaloids, tannins, saponins, steroids, and triterpenoids as potential contributors to neuroprotection through antioxidant activity.

However, limitations include the small sample size of 25 mice, a single alcohol induction without varying chronic duration, and the lack of analysis of molecular mechanisms such as MDA or AChE levels. Suggestions for further research include broader dose trials, Alzheimer's dementia models, and in vivo human studies. Practically, these results support the development of an oil palm leaf-based herbal supplement for the prevention of oxidative stress-induced memory impairment, particularly in alcoholism-prone populations, with potential commercialization following further toxicity testing.

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