



Original Article

Effect of Tea and Mango Mistletoe Extract as Dietary Adjuvant on Triglyceride in Wistar Rats

Tania Putri Nur Yasinta^{1✉}, Nour Athiroh Abdoes Sjakoe², Ari Hayati³

^{1,2,3}Universitas Islam Malang, Indonesia

Korespondensi Email: taniapny62@gmail.com[✉]

Abstract:

The increasing prevalence of obesity in Indonesia has contributed to a rise in metabolic disorders, including hypertriglyceridemia, which is a major risk factor for cardiovascular and metabolic diseases. Therefore, safe and effective natural-based therapeutic alternatives are needed. This study aimed to evaluate the effect of a combined extract of tea mistletoe (*Scurrula atropurpurea*) and mango mistletoe (*Dendrophthoe pentandra*) leaves as a dietary adjuvant on serum triglyceride levels in male Wistar rats (*Rattus norvegicus*) induced with a high-fat diet. This experimental study employed a randomized pre-test post-test control group design with five groups: negative control, positive control (high-fat diet), and three treatment groups receiving the combined extract at doses of 50, 100, and 200 mg/kg body weight (n = 7 per group). The treatment was administered orally for 37 days. Serum triglyceride levels were measured using the Colorimetric Enzymatic Test (Glycerol Phosphate Oxidase method) and analyzed using one-way analysis of variance (ANOVA). The results demonstrated a statistically significant difference in triglyceride levels among the groups (p = 0.01024). The positive control group exhibited the highest mean triglyceride level, whereas administration of the combined mistletoe extract resulted in a reduction in triglyceride levels. The most pronounced decrease was observed in the group receiving 100 mg/kg body weight, which showed the lowest mean triglyceride level among the treatment groups. The hypolipidemic effect of the combined extract is presumed to be associated with the presence of bioactive compounds such as flavonoids and polyphenols, which possess antioxidant properties and play a role in lipid metabolism regulation. In conclusion, the combined extract of tea mistletoe and mango mistletoe has potential as a natural dietary adjuvant for lowering triglyceride levels and improving lipid profiles in conditions of high-fat diet-induced dyslipidemia.

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Introduction

Obesity is a health issue that is gaining increasing attention in Indonesia. Changes in Indonesian lifestyles and unhealthy eating habits are the main factors

contributing to the rising obesity rate. Consuming high-calorie foods, reduced physical activity, and the influence of modern lifestyles contribute to the increasing prevalence of obesity. This situation triggers the emergence of various non-communicable diseases, burdening the national health system ([Nur Aini Kusmayanti, 2014](#)).

Statistical data shows that obesity rates in Indonesia have continued to rise over the past decade. This calls for strategic measures for prevention and treatment through a multidisciplinary approach, including the use of medicinal plants and diet programs. Dieting or regulating eating patterns is one of the main methods for weight control and reducing the risk of obesity. The use of diet teas and other herbal products is often promoted as part of a healthy diet strategy. However, the effectiveness and safety of various herbal products must be scientifically tested for safe and appropriate use.

The increase in blood triglyceride levels is one of the key indicators of metabolic disorders that are directly associated with the risk of cardiovascular diseases, type 2 diabetes mellitus, and obesity. Triglycerides are the primary form of fat circulating in the bloodstream and function as an energy reserve for the body; however, when present in excessive amounts, they can lead to atherosclerosis and disturbances in the circulatory system. This condition is generally caused by high-fat dietary patterns, lack of physical activity, and oxidative stress that disrupts lipid metabolism balance. The growing public awareness of health has encouraged the use of natural medicinal plants due to their high effectiveness and minimal side effects compared to synthetic drugs ([Nur Rosyada dkk., 2024](#)). Indonesia, as a megadiverse country, has great potential in the development of phytotherapy because of the abundance of tropical plant species with medicinal properties, including those with triglyceride-lowering activity ([Vevi Liswandari dkk., 2023](#)).

One promising local plant combination is tea mistletoe (*Scurrula atropurpurea*) and mango mistletoe (*Dendrophthoe pentandra*), two hemiparasitic species containing various bioactive compounds such as flavonoids, tannins, saponins, steroids, and terpenoids ([Alfais dkk., t.t.](#)). The flavonoids found in these plants play a crucial role as antioxidants capable of neutralizing free radicals, suppressing inflammatory cytokines, and reducing blood lipid levels ([Zahroh dkk., 2017](#)). The compound quercetin, also present in these mistletoes, has been shown to lower total cholesterol and triglyceride levels while increasing HDL concentrations, thereby contributing to the improvement of blood lipid profiles ([Apparesya dkk., t.t.](#)).

The antioxidant and anti-inflammatory effects of flavonoids are also known to reduce oxidative stress, which often triggers an increase in triglyceride levels. Tea mistletoe exhibits vasodilatory effects that improve blood flow and reduce oxidative pressure on blood vessel walls, indirectly enhancing lipid metabolism and lowering triglycerides ([As & Permatasari, 2013](#)). Sound that the flavonoid, tannin, and saponin contents of mistletoe exert hepatoprotective effects by protecting liver cells from oxidative damage and supporting lipid metabolism regulation in the liver (200602220002, t.t.). This is significant because the liver is the primary organ responsible for the synthesis and degradation of triglycerides. Consequently, the combination of tea and mango mistletoe is predicted to act synergistically in reducing triglyceride levels through mechanisms involving inhibition of lipogenesis and enhancement of lipolytic activity.

Indonesia's biodiversity can be utilized through herbal extract development as a complementary solution to mitigate metabolic disorders caused by elevated

triglycerides resulting from high-fat diets ([Safitri dkk., 2024](#)). In the context of experimental research, described that the extraction of mistletoe leaves was carried out using the maceration method with 90% methanol solvent to obtain extracts rich in bioactive compounds without damaging their active contents ([As & Sulistyowati, t.t.](#)).

This method was then followed by solvent evaporation using a rotary evaporator to produce a stable and concentrated extract ([Lestari dkk., 2020](#)). The quality of the extraction process greatly influences the biological activity of the extract, including its ability to lower triglyceride levels in experimental animal models. Therefore, this study employed male Wistar rats (*Rattus norvegicus*), which serve as standard laboratory models in biomedical research to evaluate the effects of high-fat diets on lipid metabolism and the response to phytotherapeutic interventions. Based on this background, it is necessary to further investigate how the combined extracts of tea and mango mistletoe influence blood triglyceride levels.

The main research questions addressed in this study are whether the administration of the combined extracts of tea mistletoe (*Scurrula atropurpurea*) and mango mistletoe (*Dendrophthoe pentandra*) as a dietary adjuvant can reduce triglyceride levels in male Wistar rats fed with a high-fat diet, and to what extent changes in triglyceride levels occur following the administration of these extracts. Thus, the purpose of this study is to analyze the effect of the combined extracts of tea and mango mistletoe on blood triglyceride levels and to assess their potential as natural phytotherapeutic agents in improving lipid profiles and reducing the risk of dyslipidemia. Through a scientific approach based on the bioactivity of natural compounds and experimental animal models, this research is expected to provide a scientific foundation for utilizing tea and mango mistletoe as safe, effective, and sustainable complementary therapies for triglyceride regulation and metabolic health improvement in the community.

Methods

Extraction

Tea mistletoe (*Scurrula atropurpurea*) and mango mistletoe (*Dendrophthoe pentandra*) extracted in the laboratory Balai Materia Medica Batu. Tea and mango mistletoe leaves were dried, powdered, and extracted. 100 grams of the simpilisa was added to 1 liter of 90% methanol. Shaking was carried out for 60 minutes and left for 24 hours until sediment formed. The resulting supernatant contained the active ingredients from tea mistletoe and mango mistletoe. The solvent was evaporated using a rotary evaporator at 35°C.

Ethical Clearance

Ethical Clearance has been published by the health research ethics committee of Malang Islamic Hospital on June 25, 2025, with the number No.36/KEPK/RSI-U/VI/2025.

Experimental Animals and Treatment

This research used wistar rats (*Rattus norvegicus*) as experimental animals. The animals used were healthy and sterile. Thirty-five rats, approximately 8 months old and weighing 150 grams, were used. Before the experiment began, the animals were acclimatized for approximately 10 days. Before the experiment began, the animals were acclimatized for approximately 10 days and then divided into five treatments (n=7 per group). After acclimatization, the animals were weighed every three days to determine

the dosage of the tea mistletoe and mango mistletoe combination extract. The animals were weighed daily to determine the dose volume administered. G1 (Negative control): standard diet only. G2 (Positive control): HFD only. G3: HFD + MESA-DP 50 mg/kgBW. G4: HFD + MESA-DP 100 mg/kgBW. G5: HFD + MESA-DP 200 mg/kgBW.

HFD Composition

HFD Composition, For the composition of the test animal feed G2 G3 G4 and G5, the ingredients used for the high-fat diet method were PARS 57.3%, wheat flour 31.8%, cholesterol 2%, and lard 8.9%. For the normal G1 test animal feed, PARS 50% and water 50% were used.

Preparation of MESA-DP extract

The preparation of the extract solution to be administered to the test animals is done by weighing the mice daily to determine the daily dose. The tea mistletoe and mango mistletoe extracts will be administered in a 3:1 ratio, 75% tea mistletoe and 25% mango mistletoe mixed with distilled water.

Treatment

The treatment was carried out for 37 days. Each day, the mice were given MESA-DP extract, the dosage of which was calculated based on their body weight. After the treatment, the mice were dissected, and blood samples were taken according to the treatment.

Triglyceride Level Determination Method

Triglyceride serum levels were determined using the Colorimetric Enzymatic Test, GPO (Glycerol Phosphate Oxidase) method. Determination of triglyceride levels was carried out using the Colorimetric Enzymatic Test (GPO) method. Triglycerides were reacted with lipoprotein lipase with the help of an indicator that would turn red, the color intensity of which was measured using a spectrophotometer at a wavelength of 500 nm, after being incubated at 37°C for 10 minutes. The procedure was carried out, namely a total of 10 µl of test serum was reacted with 1000 test reagents for triglyceride examination in a 5 ml test tube, homogenized with the help of a vortex, incubated at 37°C for 10 minutes. The same thing was done to the blank (reagent + aquadest) and standard (reagent + triglyceride standard)

Data Analysis

All data obtained from each group will be analyzed using statistical tests using the SPSS (Statistical Product and Service Solution) computer program. Values are obtained from the average SD (Degrees of Freedom). Significant differences between the averages are analyzed using the one-way analysis of variance (ANOVA) statistical test method. The expected results in this test are significant differences or differences in serum triglyceride lipid metabolism levels of white mice in the G1 negative control group, the G2 positive control group, and the G3, G4, and G5 treatment groups.

Result and Discussion

General overview of the research implementation

This experimental study aimed to determine the effect of a combination of tea

mistletoe (*Scurrula atropurpurea*) and mango mistletoe (*Dendrophthoe pentandra*) leaf extract, hereinafter abbreviated as MESA-DP, on triglyceride levels in male Wistar rats (*Rattus norvegicus*) induced by a high-fat diet (HFD). The study was conducted using a control and treatment group design with varying extract doses, allowing for the evaluation of differences in biological responses resulting from MESA-DP administration.

The male Wistar rat was used as the experimental animal model because it has relatively stable physiological characteristics, a uniform metabolic response, and is frequently used in research related to lipid metabolism disorders. All test animals were kept under relatively uniform environmental conditions, including temperature, lighting, and access to drinking water, to minimize external variables that could influence the research results.

The high-fat diet induction was carried out to create hyperlipidemia, particularly hypertriglyceridemia, which is one of the main characteristics of lipid metabolism disorders. After the induction phase, the test animals were divided into several treatment groups, each receiving MESA-DP extract at varying doses via a tube for 37 days. At the end of the treatment period, blood samples were taken to measure triglyceride levels, the primary parameter observed.

Treatment Group Division

In this study, the test animals were divided into five groups, each consisting of male Wistar rats with relatively homogeneous initial conditions. Group division was carried out to compare normal conditions, hyperlipidemia conditions without intervention, and hyperlipidemia conditions treated with MESA-DP extract at various doses.

Group P1 served as a negative control group, consisting of rats that were not given any treatment, either a high-fat diet or MESA-DP extract. This group served as a reflection of the normal physiological state of triglyceride levels in male Wistar rats. Group P2 served as a positive control group, consisting of rats that were fed a high-fat diet without MESA-DP extract. This group served as a comparison to determine the effect of HFD induction on increasing triglyceride levels. Group P3 was the treatment group given a high-fat diet and MESA-DP extract at a dose of 50 mg/kgBW using a probe. This group was used to evaluate the effects of MESA-DP administration at a low dose. Group P4 was the treatment group given a high-fat diet and MESA-DP extract at a dose of 100 mg/kgBW. This group was intended to assess the effects of MESA-DP at a medium dose. Group P5 was the treatment group given a high-fat diet and MESA-DP extract at a dose of 200 mg/kgBW. This group was used to observe the effects of MESA-DP administration at a high dose.

Triglyceride level measurements

Triglyceride levels were measured after all groups of test animals had undergone treatment for 37 days. Blood samples were taken surgically in accordance with the animal research protocol and then analyzed using biochemical methods to determine triglyceride levels in mg/dL. The results of triglyceride level measurements in each group are presented as a mean and standard deviation (SD), reflecting the trend in the mean and variation in the data within each treatment group. The results were tabulated based on the treatments of each group, as presented in the following table:

Table 1. Triglyceride Levels

Treatment	Average \pm SD
G1	49,4 \pm 8,1
G2	94,5 \pm 36,2
G3	80,8 \pm 31,4
G4	73,7 \pm 27,4
G5	88,5 \pm 88,5

Group P1, the negative control, showed a mean triglyceride level of 49.4 mg/dL with a standard deviation of 8.1 mg/dL. This value reflects the normal condition of lipid metabolism in male Wistar rats that were not exposed to high-fat feed or extract intervention. Group P2, the positive control, showed a fairly high increase in triglyceride levels, with a mean value of 94.5 mg/dL and a standard deviation of 36.2 mg/dL. This increase indicates that providing a high-fat feed is effective in increasing blood triglyceride levels, thus successfully creating a condition of hypertriglyceridemia in the test animals. Group P3, which received a high-fat feed and BTBM extract at a dose of 50 mg/KgBW, showed a mean triglyceride level of 80.8 mg/dL with a standard deviation of 31.4 mg/dL. This value is lower than the positive control group, indicating a triglyceride-lowering effect due to the administration of BTBM at a low dose. Group P4, given MESA-DP extract at a dose of 100 mg/kgBW, showed a mean triglyceride level of 73.7 mg/dL with a standard deviation of 27.4 mg/dL. This value was the lowest among all high-fat feed-induced groups, indicating that the 100 mg/kgBW dose provided the most optimal triglyceride-lowering effect numerically. Group P5, receiving BTBM extract at a dose of 200 mg/kgBW, showed a mean triglyceride level of 88.5 mg/dL with a standard deviation of 43.2 mg/dL. Although this value was still lower than the positive control group, the data variation in this group was relatively greater than in the other treatment groups.

Statistical analysis of triglyceride level data

Before testing for mean differences between groups, triglyceride level data were analyzed to ensure that the data met the basic assumptions of parametric analysis. A normality test was performed to determine whether the data distribution in each group followed a normal distribution. The results of the normality test showed that all groups had a p-value greater than 0.05, thus concluding that the triglyceride levels were normally distributed. Furthermore, a homogeneity of variance test was conducted to ensure that the data variation between groups was homogeneous. The results of the homogeneity test showed a p-value greater than 0.05, indicating that the data variance between groups was not significantly different and met the requirements for a one-way ANOVA test. A one-way ANOVA test was conducted to determine whether there was a statistically significant difference in mean triglyceride levels among all treatment groups. The ANOVA test results showed a p-value of 0.01024. This value is smaller than the 0.05 significance level, thus concluding that there was a statistically significant difference between the treatment groups in this study. These results indicate that the treatments given, both in the form of a high-fat diet and the administration of MESA-DP extract, had a significant effect on triglyceride levels in male Wistar rats. Further analysis of the treatment groups receiving MESA-DP extract with three dose variations (P3, P4, and P5) showed a p-value of 0.09854. This value is

greater than 0.05, so there is no statistically significant difference between the three doses. This indicates that although there is a difference in mean values between doses, the difference is not statistically strong enough. Data on triglyceride levels in each treatment group are presented in tabular form to facilitate reading and comparison of mean values between groups. The table contains the mean and standard deviation of triglyceride levels in mg/dL. In addition, the data is also presented in the form of a triglyceride level diagram to provide a visual illustration of the differences in values between groups. The diagram shows that the positive control group had the highest triglyceride levels, while the MESA-DP treatment group showed lower triglyceride levels and were relatively comparable to each other. The same letter notation in the diagram indicates that there is no significant difference between MESA-DP dose groups based on post-hoc analysis.

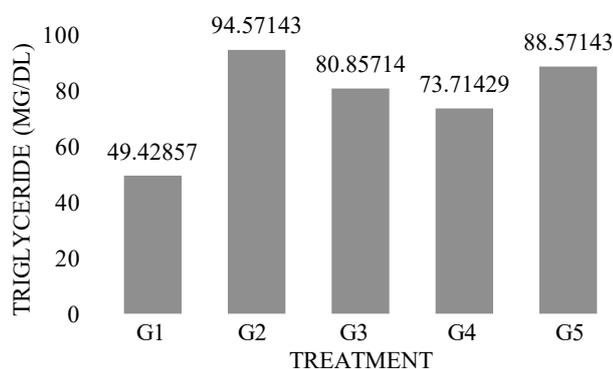


Figure 1. Diagram of Triglyceride Levels

Comparison of triglyceride levels between treatment groups

The results showed differences in triglyceride levels between treatment groups after being fed a high-fat diet and MESA-DP extract for 37 days. This difference serves as the primary basis for discussing the biological effects of a high-fat diet and the potential of a combination of tea mistletoe and mango mistletoe leaf extracts in modulating lipid metabolism. The negative control group (P1) showed the lowest triglyceride levels compared to the other groups. This is understandable because this group did not receive a high-fat diet or MESA-DP extract intervention. Triglyceride levels in group P1 reflect the normal physiological condition of male Wistar rats, with well-maintained lipid metabolism. Triglyceride levels in this group remained within the normal range, as reported by [Wardhani \(2014\) \(Wardhani, t.t.\)](#), which is 26–145 mg/dL.

In contrast, the positive control group (P2) showed a significant increase in triglyceride levels. This increase indicates that consistently feeding a high-fat diet can increase blood triglyceride levels. This condition indicates a lipid metabolism disorder characterized by increased triglyceride synthesis in the liver and a decreased ability of the body to efficiently metabolize lipids. These results align with previous studies reporting that excessive fat consumption can increase triglyceride levels through increased lipogenesis and decreased insulin sensitivity.

The treatment groups receiving MESA-DP extract (P3, P4, and P5) showed lower triglyceride levels than the positive control group. This decrease indicates that MESA-DP has a hypolipidemic effect, specifically in reducing triglyceride levels in mice induced by a high-fat diet. Although all three treatment groups showed a decrease, the

magnitude of the decrease differed between doses.

Group P3, receiving a MESA-DP dose of 50 mg/kgBW, showed lower triglyceride levels than the positive control group, but still higher than group P4. This indicates that at low doses, MESA-DP can already exert a biological effect on lipid metabolism, although this effect is not yet optimal. A dose of 50 mg/kgBW likely provides sufficient amounts of active compounds to trigger initial metabolic responses, such as increased lipoprotein lipase activity or decreased triglyceride synthesis in the liver. However, the amount of bioactive compounds available at this dose may not be sufficient to produce a maximal effect in suppressing triglyceride levels. The decrease in triglyceride levels in group P3 indicates that MESA-DP begins to work as a lipid-lowering agent at a low dose. This is important because it demonstrates the potential for using MESA-DP at a relatively safe minimum dose, although its effectiveness can still be improved with dose adjustments.

Group P4, which received a MESA-DP dose of 100 mg/kgBW, showed the lowest triglyceride levels among all groups induced by the high-fat diet. These findings indicate that the 100 mg/kgBW dose was the most optimal dose in this study. The effectiveness of this dose can be explained by the balance between the amount of active compounds administered and the test animals' ability to metabolize them. At a dose of 100 mg/kgBW, the flavonoid and polyphenol content in MESA-DP is thought to be sufficient to effectively suppress lipogenesis and increase lipolysis without triggering detrimental metabolic compensatory mechanisms. Furthermore, this dose is likely capable of optimally enhancing antioxidant activity, thereby suppressing oxidative stress caused by a high-fat diet. Reducing oxidative stress plays a crucial role in improving hepatocyte function and reducing endogenous triglyceride production.

Group P5, which received the highest MESA-DP dose of 200 mg/kgBW, showed lower triglyceride levels than the positive control, but higher than group P4. This phenomenon indicates that increasing the dose does not always lead to increased effectiveness. At high doses, the body can activate adaptive or compensatory mechanisms, such as increased metabolism of the active compound or activation of physiological stress pathways. Furthermore, high doses can also increase the metabolic burden on the liver, which can actually reduce the effectiveness of the bioactive compound in lowering triglycerides. The large variation in the data in group P5 also indicates a diverse individual response to high doses of MESA-DP. This could be due to differences in physiological conditions among the test animals or differences in the ability to metabolize the active compound.

The dose-response relationship between MESA-DP and triglyceride levels is a crucial aspect in evaluating the effectiveness of a therapeutic agent. In this study, the dose-response relationship between MESA-DP showed a non-linear pattern. A dose of 100 mg/kgBW provided the most optimal effect, while lower and higher doses showed relatively comparable effectiveness. This pattern indicates an optimal dose, where the amount of active compound administered produces maximum effect without causing side effects or compensatory mechanisms. This finding is important in the context of developing MESA-DP as a dietary adjuvant, as using an optimal dose will be more effective and safe than doses that are too low or too high.

The role of flavonoids in lowering triglyceride levels

Flavonoids are one of the main compounds contained in tea mistletoe and mango mistletoe leaves. These compounds are known to have strong antioxidant and

anti-inflammatory activities. In the context of lipid metabolism, flavonoids play a role in suppressing triglyceride synthesis and increasing fatty acid oxidation. Flavonoids are known to inhibit the activity of lipogenic transcription factors such as sterol regulatory element-binding protein-1c (SREBP-1c), which plays a crucial role in triglyceride synthesis in the liver. Furthermore, flavonoids can also activate peroxisome proliferator-activated receptor alpha (PPAR α) and AMP-activated protein kinase (AMPK), which play a role in increasing fatty acid oxidation and reducing lipid accumulation. Through this mechanism, the flavonoids in MESA-DP directly contribute to the reduction of triglyceride levels in mice induced by a high-fat diet.

The antioxidant role of MESA-DP against oxidative stress

A high-fat diet is known to increase free radical production and oxidative stress. Oxidative stress plays a key role in exacerbating lipid metabolism disorders through cell damage and mitochondrial dysfunction. MESA-DP, rich in antioxidants, plays a role in neutralizing free radicals and reducing oxidative stress. By reducing oxidative stress, MESA-DP helps improve liver cell function and suppresses endogenous triglyceride production. This is one important mechanism explaining the reduction in triglyceride levels in the treatment group.

The biological mechanism of MESA-DP in reducing triglyceride levels.

The reduction in triglyceride levels in the treatment group given a combination extract of tea mistletoe (*Scurrula atropurpurea*) and mango mistletoe (*Dendrophthoe pentandra*) leaves indicates that BTBM has biological activity that plays a role in modulating lipid metabolism. Physiologically, blood triglyceride levels are determined by the balance between triglyceride synthesis in the liver, lipid absorption from the intestine, and triglyceride breakdown by the enzyme lipoprotein lipase in peripheral tissues.

A high-fat diet is known to increase the flow of free fatty acids to the liver, which are then esterified into triglycerides and released into the circulation as very low-density lipoprotein (VLDL). This increased process leads to triglyceride accumulation in the blood and liver tissue (Wardhani, t.t.). MESA-DP administration is thought to intervene in this pathway through the activity of its bioactive compounds. Flavonoids found in tea mistletoe and mango mistletoe act as hypolipidemic agents, capable of reducing triglyceride synthesis by inhibiting lipogenic gene expression and increasing lipid breakdown (Apparesya dkk., t.t.). Thus, the decrease in triglyceride levels in the treatment group reflects an improvement in lipid metabolic balance due to MESA-DP administration.

The role of flavonoids in regulating lipogenesis and lipolysis

Flavonoids are a group of polyphenolic compounds that have been widely reported to have protective effects against lipid metabolism disorders. At the molecular level, flavonoids can suppress the activity of sterol regulatory element-binding protein-1c (SREBP-1c), a key transcription factor that regulates the expression of lipogenic enzymes such as fatty acid synthase (FAS) and acetyl-CoA carboxylase (ACC) (Liu dkk., 2025). Suppressing SREBP-1c activity will reduce fatty acid and triglyceride synthesis in the liver, thereby reducing triglyceride accumulation in hepatocytes. In addition, flavonoids can also increase the activation of peroxisome proliferator-activated receptor alpha (PPAR α), which plays a role in increasing fatty acid oxidation in

mitochondria and peroxisomes (Huang dkk., 2024). PPAR α activation contributes to increased lipolysis and reduced plasma triglyceride levels. Therefore, the flavonoid content in MESA-DP has the potential to lower triglyceride levels through two main mechanisms: suppressing lipogenesis and increasing lipolysis. High-fat diets are known to increase free radical formation and trigger oxidative stress. Oxidative stress occurs when the production of reactive oxygen species (ROS) exceeds the capacity of the body's endogenous antioxidant system. This condition contributes to lipid peroxidation, cell membrane damage, and impaired organ function, particularly the liver (Lestari dkk., 2020). MESA-DP extract contains antioxidant compounds that can neutralize free radicals by donating electrons, thereby preventing the lipid peroxidation chain reaction. Reducing oxidative stress will improve hepatocyte cell membrane integrity and maintain mitochondrial function in lipid metabolism.

Previous research has shown that flavonoids and plant polyphenols can enhance the antioxidant defense system by activating the nuclear factor erythroid 2-related factor 2 (Nrf2) pathway, which plays a role in regulating endogenous antioxidant enzymes such as superoxide dismutase (SOD) and catalase (Huang dkk., 2024). Thus, the antioxidant activity of MESA-DP indirectly contributes to lowering triglyceride levels through cellular protection against oxidative stress.

Relationship between Triglyceride Reduction and Hypertriglyceridemia Prevention

Hypertriglyceridemia is a major risk factor for metabolic disorders, including insulin resistance and cardiovascular disease. The decrease in triglyceride levels observed in the MESA-DP treatment group suggests that this extract has the potential to inhibit the development of hypertriglyceridemia caused by consuming a high-fat diet. Lower triglyceride levels reflect reduced triglyceride synthesis in the liver and increased triglyceride breakdown in peripheral tissues. This is consistent with findings that flavonoids can increase the activity of the lipoprotein lipase enzyme, which plays a role in triglyceride hydrolysis in the bloodstream (Apparesya dkk., t.t.) Therefore, administering MESA-DP can help maintain triglyceride levels within the physiological range, even when the test animals are exposed to a high-fat diet.

The Role of MESA-DP in Preventing Liver Fat Accumulation and NAFLD

Triglyceride accumulation in the liver is a key feature of non-alcoholic fatty liver disease (NAFLD). In this condition, lipid accumulation in hepatocytes triggers oxidative stress, endoplasmic reticulum stress, and chronic inflammation that can progress to liver fibrosis (Taul dkk., 2024). The concept of multiple parallel hits explains that impaired lipid metabolism, increased ROS, mitochondrial dysfunction, and inflammation work together and mutually exacerbate liver conditions (Delli Bovi dkk., 2021). Therefore, interventions that can reduce triglycerides and oxidative stress play a crucial role in preventing the progression of NAFLD. Flavonoids and tannins in MESA-DP have been reported to simultaneously suppress several pathogenetic pathways, including reducing ROS, inhibiting inflammatory pathways such as NF- κ B, and improving mitochondrial function (Huang dkk., 2024). By lowering triglyceride levels, MESA-DP reduces the lipid burden on hepatocytes, potentially preventing the development of hepatic steatosis.

Scientific Evidence Supported by Previous Research

Various studies have reported that flavonoid supplementation can lower

triglyceride levels and improve lipid profiles. A meta-analysis of clinical trials showed that flavonoid administration significantly reduced triglyceride levels, total cholesterol, and liver damage markers such as ALT and AST (Kozłowska, 2025). Furthermore, plant bioactives rich in polyphenols and tannins have been shown to reduce oxidative stress, inflammation, and liver fat accumulation in animal models of NAFLD (Zamanian dkk., 2023). These findings strengthen the findings of this study that MESA-DP, as a flavonoid-rich plant combination, has a strong scientific basis for lowering triglyceride levels.

Conclusion

Based on the results and discussion of this study, it is concluded that the subchronic administration of the combined extract of Tea Mistletoe (*Scurrula atropurpurea*) and Mango Mistletoe (*Dendrophthoe pentandra*) (BTBM) to male Wistar rats for 37 days at doses of 50 mg/KgBW, 100 mg/KgBW, and 200 mg/KgBW yielded positive results. Statistically, the triglyceride level data analysis showed results that were relatively normal and normally distributed, indicating the reliability of the method. Furthermore, functionally, the combined extract of Tea Mistletoe and Mango Mistletoe was proven to have significant potential as a dietary adjuvant supporting the improvement of the lipid profile in the animal model.

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