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Effect of Ethyl Acetate Fraction of Avocado Peel (*Persea americana* Mill.) on Total Cholesterol Levels in Hypercholesterolemic Wistar Rats

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ABSTRACT

Background: Hypercholesterolemia is a condition that can increase the risk of coronary heart disease, stroke, high blood pressure, obesity and other health problems. The ethyl acetate fraction of avocado peel offers a novel approach by isolating key bioactive compounds while separating them from other components, focusing on the desired properties of compounds such as flavonoids, saponins, and phenolics, which are well-known for their antihyperlipidemic effects.

Aims: To analyze the effect of ethyl acetate fraction of avocado peel (*Persea americana* Mill.) on total cholesterol levels of Wistar white rats with hypercholesterolemia.

Methods: This study was experimental with a pre and post test with control group design using 20 male white rats (Rattus norvegicus) of the Wistar strain that had been fed high-fat feed for 14 days and divided into 5 groups for 7 days of treatment, namely the negative control group that was given only high-fat feed, the positive control group that was given the drug simvastatin 0.18 mg/200gBW, and 3 treatment groups that were given the ethyl acetate fraction of avocado peel with a tiered dose of 100 mg/KgBW, 75 mg/KgBW, and 50 mg/kgBW. The data were analyzed using a one-way ANOVA test with a post hoc test

Results: The ethyl acetate fraction of avocado fruit peel positively contains alkaloids, flavonoids, phenolics, saponins, tannins, and triterpenoids or steroids. The average reduction in total cholesterol levels is 19.5 mg/dL ($p < 0.05$) at a dose of 100 mg/kgBW, 17.5 mg/dL ($p < 0.05$) at a dose of 75 mg/kgBW, and 13 mg/dL ($p < 0.05$) at a dose of 50 mg/kgBW.

Conclusion: The ethyl acetate fraction of avocado peel is effective in reducing total cholesterol levels with an effective dose of 100 mg/kgBW. With an effective dose of 100 mg/kg body weight that has been established, subsequent research can focus on the development of more stable and efficient formulations for clinical applications. The effect of lowering cholesterol levels is associated with the content of secondary metabolite compounds contained in the ethyl acetate fraction of avocado peels, namely flavonoids, phenolics, saponins, tannins, triterpenoids and steroids.

Keywords: *Hypercholesterolemia; Ethyl acetate fraction; Avocado peel; Persea americana Mill.*

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1. Introduction

The metabolic lipid illness hypercholesterolemia dramatically raises the risk of coronary heart disease (CHD), stroke, obesity, high blood pressure, and other serious health issues. Elevated blood levels of total cholesterol, which are linked to the onset of atherosclerosis, or the buildup of plaques in blood vessel walls, are indicative of it. Consequently, this is one of the main causes of stroke and CHD. Worldwide, heart disease and stroke account for 17.3 million of the 54 million fatalities that occur each year. Heart disease occurs in 1.5% of people of Indonesia, and it is more common in elderly populations, especially those between the ages of 65 and 74. The probability of cardiovascular disease increases with age due to the accumulation of risk factors associated with hypercholesterolemia, such as poor diet, lack of physical activity, and other lifestyle choices (Perkeni, 2021; Lin et al., 2018).

According to data from the Global Health Observatory (GHO) of the World Health Organization, hypercholesterolemia killed approximately 2.6 million people worldwide in 2008. In addition to the death toll, this causes 29.7 million people to experience certain levels of disorder or disability each year. The rise in blood cholesterol levels, which underlies hypercholesterolemia, significantly increases the risk of cardiovascular diseases such as coronary heart disease and stroke, leading to widespread morbidity and mortality across the globe. This indicates the significant impact of lipid problems on public health (World Health Organization, 2019). In Indonesia, the 2018 national basic health research found that 28.8% of the general population aged 15 years and older had problematic total cholesterol levels. This is based on the NCEP Adult Treatment Panel III (ATP III) standards, which classify abnormal cholesterol as levels equal to or greater than 200 mg/dL. The high prevalence of increasing cholesterol levels among Indonesian adults poses a serious challenge to public health by raising the risk of cardiovascular diseases such as coronary heart disease and stroke (Badan Penelitian dan Pengembangan Kesehatan RI, 2018).

High lipid levels can be lowered with lipid lowering drugs, which aim to reduce lipid levels in plasma and control disorders such as hypercholesterolemia. Statins are the main therapy for lowering LDL cholesterol, but can cause side effects such as muscle pain, cognitive impairment, and increased risk of diabetes. In addition, the cost of these drugs can be a burden, especially in developing countries (von Känel-Cordoba et al., 2024). One of the plants that grow a lot in the tropics is the avocado. The avocado plant (*Persea americana* Mill.) in addition to being abundant in Indonesia has also been known as a plant with medicinal properties by the previous community. (Bergh, 1992) The decrease in cholesterol levels is known because avocados have secondary metabolite compounds. Secondary metabolite compounds in avocados include flavonoid compounds and phenolic compounds (Tomayahu et al., 2017; Onoja et al., 2019).

Previous research has shown that avocado seeds and skins contain higher amounts of phenolics than the flesh. Avocado peel extract exhibits a significantly greater antioxidant effect than avocado seeds (Rojas-García et al., 2022). researched the Total Phenolic Content in the skin and flesh of avocados, and found that the skin has a higher Total Phenolic Content value (Lyu et al., 2023a). This indicates the potential of avocado peel to possess stronger biological activity, particularly as a natural source of antioxidants. Various antioxidant compounds work effectively to reduce the oxidation of low-density lipoprotein (LDL) cholesterol, regulate cellular signalling pathways, and reduce platelet aggregation (Młynarska et al., 2024). Nidhamuddin's research found that avocado peel extract had hypolipidemic effects at a dose of 300 mg/kg body weight (BW) in Sprague Dawley rats with dyslipidemia. This impact is characterized by a decrease in triglyceride levels and low density lipoprotein (LDL) levels, as well as an increase in high density lipoprotein (HDL). However, the optimal dose for lowering cholesterol levels with avocado skin ethyl acetate fraction has not yet been determined, highlighting the need for further research to find the most effective concentration for lipid control (Brajawikalpa, Nidhamuddin and Loebis, 2020).

Previous studies have generally used extracts, but fractions show more purified products obtained from extracts. Fractions are made by separating the main components from other groups in the extract and isolating specific bioactive compounds. This separation is done based on the characteristics of the target compound, allowing for more precise action in biological systems. Several studies have shown that semi-polar ethyl acetate fractions contain secondary metabolites that contribute to cholesterol reduction. These secondary metabolites, including flavonoids, saponins, and tannins; play an important role in the observed lipid-lowering action, making ethyl acetate fractions a major focus in the development of more efficient and targeted hypolipidemic treatments (Viviandhari et al., 2020). Therefore, research using ethyl acetate fraction components is needed to isolate secondary metabolite compounds, namely flavonoids, alkaloids, saponins, tannins, steroids, triterpenoids, and phenolics. Although it is still rare to find specific research on fractions avocado peel as anticholesterol, content of the plant likely to have the same mechanism of action in lowering the cholesterol in the blood.

Based on the results of the above study, the purpose of this study is to assess the effect of the ethyl acetate fraction of avocado peel on total cholesterol levels in hypercholesterolemic white Wistar rats, with the goal of developing low cost, effective alternatives for controlling hyperlipidemia.

2. Methods

2.1 Study design

This study was experimental with a pre and post-test with control group design using 20 male white rats (*Rattus norvegicus*) of the Wistar strain which were divided into 5 groups, namely the negative control group that was given only high-fat feed (CG1), the positive control group that was given the drug simvastatin 0.18 mg/200gBW (CG2) and 3 treatment groups (TG) groups that were given the ethyl acetate fraction of avocado peel with a tiered dose of 100 mg/KgBW (TG1), 75 mg/KgBW (TG2), and 50 mg/kgBW (TG3). This research has been approved by ethical committee from the Medical Faculty, Universitas Swadaya Gunung Jati, Cirebon with Number 19/EC/FKUGJ/IV/2024.

2.2 Measurements

The study began by preparing 20 male Sprague Dawley rats, which were separated into five groups. The rats were acclimatized for 7 days under usual conditions, with ad libitum access to food and water, to ensure they had been adequately prepared for the experiment. The following stage was to prepare the study's tools and supplies, which were then used to remove avocado peels using the maceration process. The avocado peels were steeped in a solvent to extract the beneficial components. After extraction, the crude extract was fractionated with ethyl acetate to isolate the semi-polar chemicals. A phytochemical screening was performed to evaluate whether secondary metabolites were present in the ethyl acetate fraction. This qualitative test detected a variety of bioactive chemicals, including alkaloids, flavonoids, saponins, tannins, phenolics, steroids, and triterpenoids, all of which have been linked to possible cholesterol-lowering effects in the study.

The rats developed hypercholesterolemia after being fed a high-cholesterol diet for 14 days. On the 21st day, after a 12-hour fast, blood samples were drawn from the orbital plexus for a pretest to determine total cholesterol levels. The CHOD-PAP technique (Cholesterol Oxidase Peroxidase Aminoantipyrine Phenol) was used to measure these values. Following the pretest, three treatment groups (TG1, TG2, and TG3) received the ethyl acetate fraction of avocado peel in addition to a high-cholesterol diet for seven days. On the 28th day, after another 12-hour fast, posttest blood samples were taken from the rats to determine their total cholesterol levels. The data obtained from these pretest and posttest assessments were then examined to assess the effect of the avocado peel fraction on cholesterol reduction.

2.3 Population and Samples

The study used 20 male Wistar rats as a sample and followed tight inclusion criteria to assure the experiment's integrity and dependability. The rats had to be active, 2 months old, weigh between 200-250 grams, and have no anatomical anomalies. Exclusion criteria eliminated any rats with physical problems. The sample size was estimated using the Federer's formula. Federer's formula is used to determine the minimum number of samples in experimental research. The formula is $(n-1)(t-1) \geq 15$, where n is the number of samples per treatment group and t is the number of treatment groups. The study had five groups in total (control and treatment), with 20 rats uniformly divided across all groups to achieve strong results.

2.4 Analysis Data

All research data have been statistically evaluated, starting with the normality test using the Shapiro-Wilk test (sig. >0.05 = normally distributed). Independent T-test was used to compare the control group (CG) with other groups. One-way analysis of variance (ANOVA) was used to compare cholesterol-lowering activity between treatment groups. (sig. <0.05 = there is a difference) Paired T-test was used to compare cholesterol levels before and after the test in each group (sig. <0.05 = there is a decrease). Furthermore, to compare the average cholesterol levels between groups and determine whether there is a significant difference, one-way ANOVA was used, followed by the post hoc LSD (Least Significant Difference) test for detailed pairwise comparisons.

3. Results

Phytochemical Screening

Qualitative phytochemical screening tests were carried out on Ethyl Acetate Fraction of Avocado Peel *(Persea americana Mill.)* to show the presence of several classes of secondary metabolite compounds as seen in **Table 1.**

Table 1. Results of Analysis of Phytochemical Components of Ethyl Acetate Fraction of Avocado Peel.

Chemical Compound Group	Reagent	Observation	Conclusion
Alkaloids	Bauchardat	Blackish-brown precipitate	(-)
	Dragendrauf	White Deposits	(-)
	Hager	Yellow Deposits	(+)
	Meyer + methanol + Bauchardat	Blackish-brown precipitate	(-)
Saponins	HCl 2N	Foam that settles for ± 10 minutes	(+)
Taninns	$FeCl_3$ 1%	Dark blue or greenish-black color	(+)
Flavonoids	H_2SO_4 concentrated	Red color (+) flavonoids compounds	(+)
Phenolic	NaOH 10%	Red color (+) Phenol Hydroquinone	(+)
Triterpenoids	Bauchardat	Red or purple color	(+)
Steroids	Eter + 3 drops of anhydrous acetic acid + 1 drops of H_2SO_4 concentrated	Green color	(+)

The amount of secondary metabolite chemicals in the sample can be determined qualitatively, specifically by employing the phytochemical screening method. According to the results of the phytochemical test, the ethyl acetate fraction of avocado peel contains metabolite chemicals, including flavonoids, tannins, alkaloids, saponins, steroids, phenolics, and triterpenoids.

Total Cholesterol Levels Before and After Treatment

The data measured and observed were total cholesterol levels after being given a high fat diet and total cholesterol levels after being given treatment with the ethyl acetate fraction of avocado peel. The following table shows total cholesterol levels before and after treatment.

Table 2. Effect of Ethyl Acetate Fraction of Avocado Peel on Total Cholesterol Profile of Rats

Groups	Dose (mg/KgBW)	Average Total Cholesterol Level (mg/dl)		Reduction Total Cholesterol (mg/dl)
		Pre-test	Post-test	
CG 1 (High cholesterol fed)	-	89.25	100.5	-11.25
CG 2 (Simvastatin 0.18)	-	78.25	54.5	23.75
TG 1	100	70.75	51.25	19.5
TG 2	75	72	54.5	17.5
TG 3	50	76.75	63.75	13

The data is displayed as CG = Control Group, TG = Treatment Group.

The findings of this study show that the ethyl acetate component of avocado peel decreases total cholesterol levels in hypercholesterolemic white Wistar rats in a dose-dependent manner. The greatest substantial reduction was seen in the group that received 100 mg/kg BW of the avocado peel fraction, with cholesterol levels dropping by 19.5 mg/dl, similar to the impact of simvastatin, a typical hypolipidemic medication.

Data Analysis

To determine whether the obtained data is normally distributed, a normality test is necessary. In this discussion, the normality test is conducted using the Shapiro-Wilk test.

Table 3. Normality Test

Subject Group	Treatment Group (TG)	Sig.	Results
	TG 1 (100 mg/KgBW)		
Pretest	TG 2 (75 mg/KgBW)	0.999	Normal
	TG 3 (50 mg/KgBW)		
	TG 1 (100 mg/KgBW)		
Postest	TG 2 (75 mg/KgBW)	0.185	Normal
	TG 3 (500 mg/KgBW)		

The results of the normality test in **Table 3.** of the pretest and posttest total cholesterol data show a significance value above 0.05, meaning the data is normally distributed.
In connection with the assumption of data normality being met, then to see the difference between the two averages, a paired t-test was carried out. The results of the analysis are as follows :

Table 4. Paired T-Test

	Total Cholesterol Level	Sig.
Pair 1	TG 1 (100 mg/KgBW)	
Pair 2	TG 2 (75 mg/KgBW)	<0.05
Pair 3	TG 3 (50 mg/KgBW)	

The results from the **Table 4.** show that the treatment group showed a significant value of less than 0.05, meaning that there was a decrease in total cholesterol after administering the ethyl acetate fraction of avocado peel.
To determine whether there is a statistically significant difference between the means of the three groups, a One-Way ANOVA test is necessary. The following table shows the results of the One-Way ANOVA test:

Table 5. One Way Annova Test

Treatment Group (TG)	Average Cholesterol Decrease (mg/dl)	Sig
TG 1 (100 mg/KgBW)	19.5	
TG 2 (75 mg/KgBW)	17.5	0.048
TG 3 (50 mg/KgBW)	13	

The test results obtained a Sig. 0.048 (<0.05), which means there is a difference in each treatment in reducing total blood cholesterol levels.

Table 6. Post-Hoc Test

(I) Group	(J) Group	Mean Difference (I-J)	Sig.
TG 1 (100 mg/KgBW)	TG 2	-2.00	1.00
	TG 3	-6.50	0.05
TG 2 (75 mg/KgBW)	TG 1	2.00	1.00
	TG 3	-4.50	0.23
TG 3 (50 mg/KgBW)	TG 1	6.50	0.05
	TG 2	4.50	0.23

To determine which treatment groups significantly differ in reducing total blood cholesterol levels in hypercholesterolemic white rats, a post hoc test was conducted using the Post-Hoc Test. Based on **Table 5,** the results of the post hoc test there are differences in each treatment regarding the decrease of total blood cholesterol levels, where TG1 compared to TG2 and TG3 shows a negative Mean Difference (I-J) value, meaning that TG1 with the administration of 100 mg/KgBW of ethyl acetate fraction from avocado peel is more effective in lowering cholesterol than TG2 and TG3. Therefore, the conclusion is that the greater the dose given, the more effective it is in lowering total cholesterol. The avocado peel fraction's cholesterol lowering efficacy is most likely attributed to its high concentration of secondary metabolites such as flavonoids, saponins, tannins, and phenolics. These findings show that the avocado peel fraction could be a natural, cost effective way to manage hyperlipidemia.

4. Discussion

In this study, the Negative Control Group (CG1), which received a combination of standard feed and high-fat feed (duck egg yolk), showed a significant increase in average total cholesterol levels. These findings support existing literature showing that the high cholesterol content in duck egg yolks can significantly increase cholesterol levels in rats. Specifically, duck egg yolks contain approximately 1000 mg of cholesterol per 100 grams, and administration of 2 grams per 200 grams of body weight has been shown to significantly increase cholesterol levels in white Wistar rats. The significant increase in cholesterol levels observed in CG1 confirms the effectiveness of a high fat diet in inducing hypercholesterolemia for this study (Budiyanto et al., 2023).

The decrease in cholesterol levels observed in the Positive Control Group (CG2), which was given simvastatin, highlights the effectiveness of this drug in managing hypercholesterolemia. Simvastatin is a proven effective hypolipidemic agent that works by inhibiting the activity of the HMG-CoA reductase enzyme. This enzyme plays an important role in the production of cholesterol by the liver. Simvastatin inhibits HMG-CoA reductase, which efficiently reduces cholesterol synthesis, leading to a significant decrease in blood cholesterol levels. This mechanism underlies the drug's effectiveness in lowering cholesterol and confirms its role as a standard treatment for hypercholesterolemia (Gunawan, 2012). In this study, the simvastatin dose used for the positive control group (CG2) was 0.18 mg per 200 grams of body weight (BW). This dose was calculated based on the conversion of the standard human dose of 10 mg to the appropriate rat dose, as described by Laurance and Bacharach. Using this conversion, the simvastatin dose in the animal model was guaranteed to be appropriate for assessing its hypocholesterolemic effects.

Similarly, the treatment group (TG) that received the ethyl acetate fraction of avocado peel showed a dose-dependent decrease in cholesterol levels. Each dose of avocado peel fraction caused a decrease in cholesterol levels, highlighting the potential of this natural extract in managing hypercholesterolemia. The following is a graph showing the average cholesterol levels of each group:

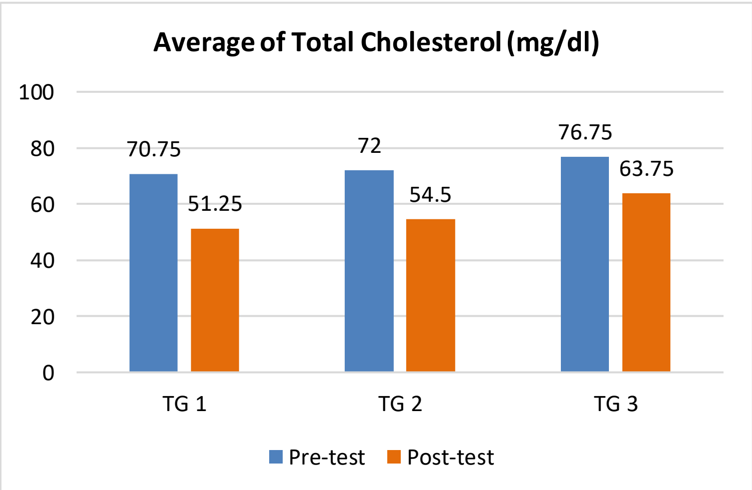

Figure 1. Average Total Cholesterol Levels between pretest and posttest during treatment. TG 1=Treatment Group 1 (Dose 100 mg/KgBW); TG 2= Treatment Group 2 (Dose 75 mg/KgBW); TG 3= Treatment Group 3 (Dose 50 mg/KgBW).

In this study, the treatment group given 100 mg/kg body weight of avocado peel ethyl acetate fraction experienced a decrease that was almost the same as the group using 0.18 mg simvastatin. This is suspected because of the composition of secondary metabolite compounds found in the ethyl acetate fraction of avocado peels, namely alkaloids, flavonoids, phenolics, saponins, tannins, and triterpenoids or steroids.

Previous research by Lyu (2023) found that avocado skin has the highest phenolic compound content compared to the seed and flesh. Catechins and flavonols are among the most common phenolic compounds. Catechins, along with carbohydrates and gut flora, have been found to increase fat metabolism through the activation of Adenosine Monophosphate Protein Kinase (AMPK) (Lyu et al., 2023). AMPK regulates lipid metabolism, particularly in the liver. When activated, AMPK inactivates Acetyl-CoA Carboxylase (ACC), which reduces fat production. In addition, AMPK inhibits the activity of HMG-CoA reductase, the main enzyme involved in cholesterol production, thereby lowering cholesterol levels. This mechanism explains the cholesterol lowering effect found in this study, which shows that the ethyl acetate fraction of avocado peel, which contains phenolic compounds, dramatically lowers cholesterol levels in treated mice (Rothenberg, Zhou and Zhang, 2018; Isemura, 2019).

Quercetin is one of the main flavonols and one of the five chemical subclasses of flavonoids, and has been linked to improved lipid profiles and liver protection. Its positive effects are largely due to its antioxidant properties, which neutralize free radicals and minimize oxidative stress, the main cause of lipid oxidation and cholesterol buildup. Quercetin also increases nitric oxide (NO) levels, which promotes vasodilation and blood flow, thereby improving cardiovascular health. These combined effects enable quercetin to improve lipid metabolism, lower cholesterol levels, and protect the liver from damage caused by a high fat diet and hypercholesterolemia. This mechanism may help explain the cholesterol lowering effects observed in the treatment group receiving the ethyl acetate fraction of avocado skin, which contains flavonols such as quercetin (Romero et al., 2010).

Flavonoids have been shown to lower blood cholesterol levels, especially in rats with hyperlipidemia. Flavonoids can inhibit the enzymes HMG-CoA reductase and ACAT, as well as increase the expression of LDL receptors, which contribute to lowering LDL and total cholesterol levels in the blood. In addition, flavonoids can also increase the expression of LXRα and ABCA1, which play a role in the removal of cholesterol from macrophages, reducing the formation of foam cells, and preventing the development of atherosclerosis (Palumbo et al., 2025). The main mechanism by which saponins and tannins lower total cholesterol is by preventing reabsorption and increasing cholesterol excretion (Jesch and Carr, 2017a). Saponins modulate the composition of the gut microbiota, stimulate signaling pathways associated with FXR and TGR5, help stabilize blood glucose levels, improve insulin sensitivity, and support bile acid balance, while also promoting its excretion to lower cholesterol levels and manage metabolic disorders (Cao et al., 2024).

Previous studies have shown that certain polyphenols, such as tannins, can increase the expression of the CYP7A1 enzyme, which plays a role in converting cholesterol into bile acids in the liver. This increased CYP7A1 activity can promote greater bile acid production, thereby facilitating the excretion of more cholesterol through feces (Chambers et al., 2019).

The ability of steroid compounds to inhibit cholesterol through various mechanisms, including competition between cholesterol and phytosterols in the blood, increased excretion of excess absorbed cholesterol, decreased serum cholesterol levels, and inhibition of exogenous cholesterol absorption and reabsorption in the gastrointestinal tract (Jesch and Carr, 2017b). Previous studies have shown that triterpenoids, both in the form of saponins and isolated compounds, have the ability to act as natural inhibitors of pancreatic lipase enzymes. By inhibiting the activity of these enzymes, the breakdown and absorption of triglycerides is inhibited, which has the potential to cause a decrease in cholesterol and triglyceride levels in the bloodstream (Lunagariya et al., 2014; Patil et al., 2021). Alkaloids can inhibit the activity of pancreatic lipase enzymes, which play a role in fat digestion. Inhibition of these enzymes causes an increase in fat excretion through feces, thereby reducing the amount of fat absorbed by the body and preventing its conversion into cholesterol (Maryati, Susilowati and Aspiyanto, 2020).

In this study, the ethyl acetate fraction had a clear advantage because it could separate and concentrate the main bioactive compounds, such as flavonoids, saponins, and phenolics, from other non-essential components. This process produces higher concentrations of secondary metabolites, which have the potential to provide more specific, consistent, and measurable hypolipidemic effects compared to crude extracts. Unlike previous studies that generally used crude avocado peel extracts, in which bioactive compounds remained mixed with other components, this study used a purer ethyl acetate fraction (Hadisaputro and Ramlan, 2019). (Ulkhasanah et al., 2019) showed that the combination of simvastatin and flavonoids from dark chocolate can significantly reduce cholesterol levels by up to 57.06 mg/dL in 15 days. Conversely, this study found that the ethyl acetate fraction of avocado peel reduced cholesterol levels differently at different doses, with a maximum reduction of 19.5 mg/dL at a dose of 100 mg/kg body weight. The striking differences in cholesterol reduction are likely due to variations in the source of bioactive compounds, flavonoid concentration, duration of administration, and type of experimental subjects (hypertensive humans vs. hypercholesterolemic Wistar rats). Furthermore, although the mechanism of action of both interventions is related to HMG-CoA reductase inhibition and increased cholesterol excretion, the more complex secondary metabolite profile of avocado peel suggests that its clinical efficacy may require different treatment durations and formulation strategies to achieve effects comparable to those observed in the dark chocolate study.

5. Conclusion

The ethyl acetate component in avocado peel has been proven to be beneficial in lowering total cholesterol levels, with the most effective dose being 100 mg per kilogram of body weight. The presence of secondary metabolites in the fraction, such as flavonoids, phenolics, saponins, tannins, triterpenoids, and steroids, is strongly associated with cholesterol lowering benefits. These components work together to lower cholesterol levels by inhibiting cholesterol synthesis, increasing cholesterol excretion, and reducing LDL oxidation, making the avocado peel fraction a promising natural treatment for hypercholesterolemia.

These results highlight the strong clinical potential of using natural compounds for the treatment of hypercholesterolemia in humans, offering a safer and more cost effective alternative to conventional statin therapy. However, further studies are essential to confirm the clinical feasibility of ethyl acetate extract from avocado peel. This includes assessing the safety profile, potential toxicity, and longterm efficacy through randomized controlled clinical trials, as well as comprehensive pharmacokinetic and pharmacodynamic evaluations.

Conflict of Interest

The authors declare no conflicts of interest for the result.

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