



# Test of the Effectiveness of Anti-Dyslipedemia Extract Ethanol Mangosteen Peel (Garcinia Mangostana L.) in Male Mice Fed a High-Fat Diet

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#### Abstract:

Dyslipidemia is a major risk factor for atheroscler heart disease, stroke, and is often defined as abnormalities or disruption of lipid metabolism. Garcinia mangostana L. is famous for its antiinflammatory properties and is used in the treatment of skin infections and wounds. The main phytochemicals present in this species are anisoprenylated xanthone, many reports of biological effects, such as antioxidant, pro-apoptosis, anti-proliferative, anti-nosiseptif, anti-inflammatory, neuroprotective, hypoglycemic, and anti-obesity. This study aims to find out the effectiveness of mangosteen peel ethanol extract as an anti-dyslipidemia in male wistar rats given a high-fat diet. This type of research is experimental with a Pre-test approach and Post-test group only control design. The samples used were mangosteen peel ethanol extract and male wistar rats, with the size of the sample calculated with Federer's formula. Analyze data with the One-Way Anova Test if the data is normally distributed with advanced tests in the form of Post Hoc Tukey HSD tests to see real differences between treatments. The results of the total cholesterol study in the entire treatment group of mice showed a significant difference in P values < 0.05. Triglyceride levels in the entire treatment group also showed significant differences, this can be seen from the value of P < 0.05 (Value P = 0.029). LDL levels also showed significant differences across the treatment group, which can be seen from the P value of < 0.05. HDL levels make a significant difference in the value of P < 0.05 (Value P = 0.029). SGOT and SGPT levels in the entire group of rat treatment showed significant differences, this was seen from the value of P < 0.05. The conclusion that mangosteen peel ethanol extract significantly lowered total cholesterol, triglyceride levels, LDL levels, SGOT levels compared to the control group. Mangosteen peel ethanol extract can significantly increase HDL levels compared to the control group.

# Keywords:

dyslipedemia; garcinia mangostana; fat

#### I. Introduction

Dyslipidemia is a major risk factor for coroner's heart disease, and is often defined as abnormalities or disruption of lipid metabolism due to the interaction of genetic and environmental factors (Erwinanto et al., 2013; Arsana et al., 2015). Based on data from the World Health Organization (WHO) in 2008, estimates that the prevalence of dyslipdemia in various regions varies by 30.3% in Southeast Asia, 47.7% in the Americas (Lin et al., 2018); (Go et al., 2014). High cholesterol turns out to be an etiology that very often causes atherosclerosis, stroke, and cardiovasculer disease (Taqwin, 2014). As many as 35.9% of Indonesians aged ≥ 15 years with abnormal cholesterol levels (based on NCEP ATP III, with cholesterol levels ≥ 200 mg / dl) where women are more than men and urban more than in rural areas (Badan Penelitian Dan Pengembangan Kesehatan Kementerian Kesehatan RI, 2013)

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In the management of dyslipidemia, there are several anti-dyslipidemia drugs on the market including statins, fibrats, niacin, ezetimibe, and bile acid binding resins (Purva, Sharma and Khan, 2020). However, the use of these drugs shows some adverse side effects of health (Saragih, 2020). So that alternative treatments such as herbal medicines are needed, which certainly have lower side effects (Anneke and Sulistiyaningsih, 2018). Indonesia is available about 30,000 species of plants, including medicinal plants that amount to 2,500 species of plants (Dalimartha and Adrian, 2013). One of the natural ingredients that have the potential to be an alternative treatment is the skin of mangosteen fruit. So far the use of mangosteen skin is only for tanning skin, traditional medicine, and materials that make antiques and textile dyes. The utilization of mangosteen peel for treatment in Indonesia is still not much, especially as Anti-Dyslipidemia. Therefore, this study aims to find out the effectiveness of mangosteen peel ethanol extract as an anti-dyslipidemia in male Wistar rats given a high-fat diet.

#### II. Review of Literature

Garcinia mangostana L. (mangosteen, Clusiaceae) has long been used as a medicinal plant. Traditionally mangosteen is famous for its anti-inflammatory properties and is used in the treatment of skin infections and wounds (Jang et al., 2008). The main phytochemicals present in this species are xanthone isisoprenylated, a class of secondary metabolites with many reports of biological effects, such as antioxidants, pro-apoptosis, anti-proliferative, antinosiseptif, anti-inflammatory (Parmita, in and Armyanti, 2017), neuroprotektif, hipoglikemik, dan anti-obesitas. Currently mangosteen peel is widely developed as a new drug to treat chronic and degenerative diseases (Ovalle-Magallanes, Eugenio-Pérez and Pedraza-Chaverri, 2017). According to (Putra SR, 2012), Mangosteen peel contains organic compounds namely xanthones. Pasaribu, dkk. (2012), Ethanol extract 96% mangosteen peel contains chemical compounds alkaloida, flavonoids, glycosides, saponins, tannins and steroids / triterpenoids (Bahri, Pasaribu and Sitorus, 2012). The content of flavonoids and alkaloids mangosteen skin can have an effect as an analgesic. In addition, flavonoids are able to inhibit prostaglandins so that they have antipyretic effects (Puspitaningrum, Kusmita and Setyani, 2014). Dyslipidemia is defined as a lipid metabolic disorder characterized by an increase or decrease in lipid fraction in plasma.

# III. Research Methods

This type of research is experimental with a Pre-test approach and Post-test group only control design. The samples used are mangosteen peel ethanol extract and male wistar rats, with the size of the sample calculated with Federer's formula, so it takes at least 4 male wistar rats (Rattus norvegicus) in each treatment group.

Table 1. Aspects of Measurement of Research Variables

No	Variabel	Cara Ukur	Alat Ukur	Hasil Ukur	Skala Ukur
1.	Dosage of mangosteen peel ethanol extract	Measured the weight and volume of extracts and vehiculum extracts with analytical scales and pumpkin measures.	Analytical scales and measuring pumpkins.	<ol> <li>Control</li> <li>Standard</li> </ol>	Ordinal
2.	Profile Lipid	Lipoprotein analysis can measure blood levels of the amount	Spektroskopik	Deep mg/dl	Ratio

		of cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides.			
3.	Up to Kolestrol Total	Combined amount of LDL cholesterol, HDL cholesterol, and triglycerides in each deciliter of blood.	Autocheck ®	Deep mg/dl	Ratio
4.	Weight	Weighed using scales.	Analytical scales	Deep gram	Ratio

Sample data such as gender, age, intrapulmonary symptoms, extrapulmonary symptoms, comorbidities, SGOT and SGPT enzyme test results when the patient was admitted to the ICU or from the first examination data when the patient was admitted to the ICU Infection Center, prognosis. The normality test used the Kolmogorov-Smirnov test, then the correlative test used the Pearson test, the Kruskal-Wallis test to assess each group of elevated transaminase enzymes on the prognosis of COVID-19 patients and the Chi-Square test to assess the correlation of intrapulmonary symptoms, extrapulmonary symptoms and comorbid diseases to the increase transaminases enzymes. Statistical analysis using SPSS 22.0 for windows program.

# 3.1 Tool

Surgical tools, laboratory glass tools, aluminum foil, blender (Miyako), porcelain cups, deikators, incubators, glass objects, cover glass, porcelain crusts, dryer cabinets, microtubes, light microscopes, analytical balance sheets (Vibra AJ), oral sonde, electric oven (Stork), water handler (Yenaco), tube clamps, test tube racks, rotary evaporators, centriofigators, a set of water content determination tools, UV spectrophotometers (Microlet 3000), injection spuits, tanurs (Nabertherm), test tube, animal scales (Presica).

#### 3.2 Material

The ingredients used in the study were mangosteen fruit, methanol, Aquades, Na-CMC (Sodium-Carboxyl methylcellulose), simvastatin, chaff, rat food pellets, phytochemical screening reagents, and ketamine.

# 3.3 Research Procedure

Samples of mangosteen fruit used in this study were obtained from one of the traditional markets in Medan City. Then the sample of mangosteen fruit was later identified at the Herbarium Medanense FMIPA USU. Mangosteen peel proceeds to the manufacture of simplisia (Kosasih et al., 2019), ethanol extract (Depkes RI, 1979), phytochemical screening (Widowati et al., 2016, 2017, 2018).

# 3.4 Anti-Dyslipidemia

Manufacture of Na CMC Suspension 0.5%, as much as 0.5 grams of Na CMC sprinkled into lumpang containing hot distilled water as much as 10 mL (Mutia and Chiuman, 2019). Making hyperchoestrolemia feed suspension, the suspension is made by mixing 300 grams of animal fat into 100 ml of aquadest and 200 grams of poultry egg yolk into 1 ml of Na-CMC 0.5% (Harsa, 2014). Suspension of Mangosteen Peel Extract, As much as 1.2grams of mangosteen peel extract is put into lumpang and added suspension Na CMC 0.5% little by little while being eroded until homogeneous and then put into pumpkin of course 10 mL. The volume is sufficient with a 0.5% Na CMC suspension up to the mark line (Mutia and Chiuman, 2019). Simvastatin suspension, as much as 10 mg of simvastatin is eroded in

lumpang until it becomes powder, then added 0.5% Na CMC suspension and then put into lumpang and added suspension Na CMC 0.5% little by little while being eroded until homogeneous and then put into pumpkin of course 10 mL. The volume is sufficient with a 0.5% Na CMC suspension up to the mark line (Mutia and Chiuman, 2019). Simvastatin suspension, as much as 10 mg of simvastatin is eroded in lumpang until it becomes powder, then added 0.5% Na CMC suspension and then put into the pumpkin of course 25 mL. Volume is sufficient with a 0.5% Na CMC suspension up to the mark line (Fouad and Jresat, 2013; Aldahmash and El-Nagar, 2016). Induction of Dyslipidemia in Animals Try, the induction process is done by giving a high-fat diet to the animal try for 14 days. A high-fat diet is provided with a high-fat feed suspension with a dose of 15 gr / kgBB for animal fat suspension and 10 gr / kgBB for poultry egg yolk suspension (Harsa, 2014; Untari and Pramukantoro, 2020).

# 3.5 Test Animal Testing

Dosage of ethanol extract mangosteen fruit skin and simvastatin as standard group, determined based on previous studies (Olayinka *et al.*, 2014; Batubara, Sabri and Tanjung, 2017; Worotikan, Tuju and Kawuwung, 2017; Abarikwu *et al.*, 2020). The treatment experienced by each of the mice in the group is as follows:

Table 2. Overview of the Treatment of Each Group

No	Test Group	Treatment
1.	Normal	Test animals are not given certain treatment and are only fed and drank on an ad libitium basis.
2.	Control	Test animals were given 1 ml of uspense Na CMC 0.5% once a day for 14 days. Food and drink are given ad libitum.
	Standard	Test animals were given uspense oral simvastatin 5 ml/kgBB
3.	(25  mg/kgBB)	once a day for 14 days. Food and drink are given ad libitum.
4.	Mangosteen Peel Ethanol Extract – I (300 mg/ kgBB)	Test animals were given mangosteen peel ethanol extract doses of 2.5 ml/kgBB once a day for 14 days. Food and drink are given ad libitum.
5.	Mangosteen Peel Ethanol Extract – II (600 mg/kgBB)	Test animals were given a 5 ml/kgBB dose of mangosteen peel ethanol extract once a day for 14 days. Food and drink are given ad libitum.
6.	Mangosteen Peel Ethanol Extract – III (1200 mg/kgBB)	Test animals were given a 10 ml/kgBB dose of mangosteen peel ethanol extract once a day for 14 days. Food and drink are given ad libitum.

# 3.6 Data Analysis

Analyze Anova's One-Way Test data if the data is normally distributed with advanced tests in the form of Post Hoc Tukey HSD tests to see real differences between treatments. However, as an alternative test if the distributed data is not normal, the Kruskall-wallis test is used as an alternative test.

#### IV. Discussion

#### 4.1 Results

#### a. Characteristics of Extract

After extraction by maceration method against mangosteen peel samples found the following extract characteristics:

**Table 3.** Characteristics of Ethanol Extract Mangosteen Peel (Garcinia mangostana L.)

Characteristic	Value
Weight of Fresh Simplisia (gr)	500 gr
Dry Simplisia Powder Weight (gr)	212 gr
Solvent Volume (ml)	2120 ml
Weight extract (gr)	15,55 gr
Yield (%)	7.33%

From the table data above it can be seen that from 500 grams of mangosteen peel samples were found to be extracts amounting to 15.55 grams. Thus, the amount of yield obtained from mangosteen peel ethanol extract is 7.33%. Phytochemical screening results of phytochemical screening in samples of mangosteen peel ethanol extract can be seen in the following table.

**Table 4.** Phytochemical Screening Results of Mangosteen Peel Ethanol Extract

Fitokimia	Reactor	Result	
Alkaloid	Bouchardart	+	
	Mayer	+	
	Dragondroff	-	
	Wagner	+	
Saponin	Aquadest + Alcohol 96%	-	
Flavonoid	FeCl3 5%	+	
	$Mg_{(s)} + HCl_{(p)}$	-	
	NaOH 10%	-	
	$H_2SO_4$ (p)	-	
Tanin	FeCl <sub>3</sub> 1%	+	
Steroid dan Terpenoid	Salkowsky	-	
	Liberman Bouchard	+	

From the table data above it can be seen that mangosteen peel ethanol extract contains several phytochemical compounds including Alkaloids, Saponins, Flavonoids, Tannins, as well as Steroids and Terpenoids.

# b. Evaluation of Anti-Dyslipidemia Effects

All parameters evaluated in the study included body weight, total cholesterol, lipid profile, SGOT levels, and SGPT analyzed the normality of the data using the Shapiro-Wilk test. The results of the normality analysis can be seen in the table below.

**Table 5.** Data Normality Test Results with Shapiro-Wilk Test of All Research Parameters

Parameter		P-Value	Data Distribution
Weight		0.396	Normal
Total Cholesterol Before Induction		< 0.05	Abnormal
Total Cholesterol A	fter Induction	< 0.05	Abnormal
Profil Lipid After	Total Cholesterol	0.489	Normal
treatment	Trigliserida	0.003	Abnormal
	levels HDL	< 0.05	Abnormal
	levels LDL	0.132	Normal
levels SGOT		< 0.05	Abnormal
levels SGPT		0.052	Normal

From the table data above it can be seen that the data on weight, total cholesterol and LDL levels of the lipid profile after treatment, and SGPT levels have a normal data distribution, while other parameters include: total cholesterol before and after induction, triglyceride levels, HDL levels, and abnormally distributed SGOT levels. Based on the distribution of these data, the data with normal data distribution is analyzed with parametric satistics while abnormal data is analyzed with non-parametric statistics.

#### c. Rat Weight

To uniformize the weight of the mice used in the study, all the mice used in the study weighed their weight first. Then a comparison was made on the entire weight of the mice. The results of the comparison can be seen in the following table:

**Table 6.** Comparison of Early Weight of Mice in the Entire Treatment Group

Treatment Group	Weight (gran	P-Value	
	Mean	SD	
Normal	245.00	37.79	
Standard	239.75	15.61	
Control	248.50	23.67	0.987
Mangosteen Peel Ethanol Extract - I	248.50	25.59	0.967
Mangosteen Peel Ethanol Extract -II	239.75	23.62	
Mangosteen Peel Ethanol Extract -III	240.75	13.89	

From the table data above can be seen the value of P > 0.05 (Value P = 0.987) which means there is no significant difference to the initial weight of the mice used in this study. The

weight span of the mice used in the study ranged from 212-300grams evenly spread across each treatment group.

#### d. Total Cholesterol

In evaluating the anti-dislipidemia effects of mangosteen peel, a high-fat diet was administered to the control group, standard, mangosteen peel extracts I, II, and III. Before and after the high-fat diet, total cholesterol in all mice was measured and all total cholesterol data was analyzed with non-parametric statistics. The results of the analysis can be seen in the following table.

**Table 7.** Comparison of Total Cholesterol before and after High-Fat Diet in All Treatment

Treatment Group	Total Cholesterol (mg/dL)		
	Before induction	After induction	
Normal	116.50 (110-117)	118.50 (112-121) <sup>b</sup>	
Standard	112.00 (100-115)	211.00 (209-213) <sup>a</sup>	
Control	115.50 (110-118)	210.50 (210-212) <sup>b</sup>	
Mangosteen Peel Ethanol Extract - I	115.50 (110-117)	210.50 (208-214) <sup>b</sup>	
Mangosteen Peel Ethanol Extract -II	110.50 (100-115)	210.50 (209-212) <sup>b</sup>	
Mangosteen Peel Ethanol Extract -III	117.50 (117-120)	209.00 (208-213) <sup>b</sup>	
P-Value	0.886	0.029	

The data is displayed as Median (Range). The value of P is derived from the Kruskal-Wallis analysis; Different superscripts in the same column show significant differences.

From the table data above it can be seen that before being given a high-fat diet, the total cholesterol of mice before the administration of a high-fat diet in the entire treatment group showed no significant difference (Value P = 0.866). This showed that the total cholesterol data of mice before being given a high-fat diet was uniform. However, total cholesterol in the entire group of mice after a high-fat diet showed a different distribution, with only the control group, standard, ethanol extract from mangosteen fruit skin I, II, and III showing a uniform total cholesterol.

# e. Lipid Profile

At the end of the study, all of the mice were terminated for blood and analyzed lipid profile and liver function (SGOT/SGPT). Comparison of plipid profiles across the mouse treatment group can be seen in the table below.

**Table 8.** Comparison of Lipid Profiles in the Entire Group of Rat Treatments

Treatment Cross	•	Lipid Profile			
Treatment Group	Total Kolestrol*	Trigliserida**	LDL*	HDL**	
Normal	$134.50 \pm 2.40a$	98.50 (97-100)a	52.25 ± 1.71a	62.50 (61- 64)a	
Standard	$144.50 \pm 0.58$ b	102.50 (101-105)b	62.50 ±1.29b	61.50 (60- 63)a	

P-Value	< 0.05	0.029	< 0.05	0.029
Mangosteen Peel Ethanol Extract - III	151.75 ± 0.96e	110.00 (109-112)f	$68.50 \pm 1.29 f$	61.00 (60- 63)a
Mangosteen Peel Ethanol Extract - II	$163.25 \pm 2.22e$	120.50 (119-122)e	77.50 ± 1.29e	61.50 (61- 63)a
Mangosteen Peel Ethanol Extract - I	$168.25 \pm 1.50d$	133.50 (133-135)d	83.75 ±2.62d	57.50 (56- 59)b
Control	$179.25 \pm 6.02c$	166.50 (162-179)c	106.00 ±3.65c	29.50 (38- 43)b

<sup>\*</sup>The data is displayed as Mean ± SD. The value of P is obtained from the one way ANOVA analysis; \*\*Data is displayed as Median (Range). The value of P is derived from the Kruskal-Wallis analysis; Different superscripts in the same column show significant differences.

From the table data above it can be seen that all lipid profile data in the entire treatment group showed significant differences.

- a. Total cholesterol in the entire treatment group of mice showed a significant difference, this can be seen from the value of P < 0.05. The average total cholesterol was lowest in the normal group of  $134.50 \pm 2.40$  mg/dL, followed by the standard group of  $144.50 \pm 0.58$  mg/dL, the mangosteen peel ethanol extract group I, II, III, and the group with the highest total cholesterol was the control group of  $179.25 \pm 6.02$  mg/dL.
- b. b. Triglyceride levels in the entire treatment group also showed significant differences, this can be seen from the value of P < 0.05 (Value P = 0.029). The lowest trend of triglyceride levels was found in the normal group of 98.50 mg / dL, followed by the standard group of 102.50 mg / dL, the ethanol extract group mangosteen fruit skin I, II, III, and the group with the highest triglyceride levels was the control group of 166.50 mg / dL.
- c. C. LDL levels also showed significant differences across the treatment group, this can be seen from the value of P < 0.05. The lowest average LDL levels were found in the normal group of  $52.25 \pm 1.71$  mg/dL, followed by the standard group of  $62.50 \pm 1.29$  mg/dL, the ethanol extract group mangosteen fruit skin I, II, III, and the group with the highest LDL levels was the control group of  $106.00 \pm 3.65$  mg/dL.
- d. d. HDL levels also showed significant differences across the treatment group, this can be seen from the value of P < 0.05 (Value P = 0.029). The highest hdl levels were found in the normal group of 62.50 mg /dL, followed by the standard group of 61.50 mg / dL, the ethanol extract group mangosteen fruit skin I, II, III, and the group with the lowest HDL levels was the control group of 29.50 mg / dL.

# f. Liver Function

Another parameter that was also assessed in the entire group of mice at the end of the study was liver function, namely: SGOT and SGPT levels. Comparison of SGOT and SGPT levels in the entire group of rat treatment can be seen in the table below.

Table 9. Comparison of SGOT and SGPT Levels in All Treatment Groups

Treatment Group	Levels SGOT (U/L)	Levels SGPT (U/L)
Normal	28.50 (27-30) <sup>a</sup>	$47.25 \pm 1.50^{a}$
Standard	110.50 (108-112) <sup>b</sup>	$171.50 \pm 1.29$ <sup>b</sup>
Control	168.50 (162-170) <sup>c</sup>	$97.25 \pm 1.50^{\circ}$
Mangosteen Peel Ethanol Extract - I	118.50 (118-120) <sup>d</sup>	$100.75 \pm 3.59$ <sup>d</sup>

Mangosteen Peel Ethanol Extract -II	122.50 (121-124) <sup>e</sup>	115.50 ± 4.51°
Mangosteen Peel Ethanol Extract -III	130.50 (129-132) <sup>f</sup>	$142.50 \pm 2.08$ <sup>b</sup>
P-Value	0.029	< 0.05

<sup>\*</sup>The data is displayed as Mean ± SD. The value of P is obtained from the one way ANOVA analysis; \*\*Data is displayed as Median (Range). The value of P is derived from the Kruskal-Wallis analysis; Different superscripts in the same column show significant differences.

From the table data above, it was seen that SGOT and SGPT levels in the entire rat treatment group showed significant differences, this is seen from the value of P < 0.05. The tendency of the highest SGOT levels was found in the control group which was 168.50 U / L and the lowest normal group was 28.50 U / L. Meanwhile, a similar picture was found in the SGPT level, the group with the highest SGPT level was found in the control group which was 171.50 U / L and the low was added to the normal group of 47.25 U / L.

#### 4.2 Discussion

The results of this study showed that mangosteen peel ethanol extract showed significant improvements in lipid profile at the end of the study. Mangosteen peel ethanol extract at the highest dose showed the most optimal improvement in lipid profile. This can be seen from the decrease in total cholesterol levels, triglycerides, and LDL as well as an increase in HDL levels of the mangosteen skin ethanol group II and III. However, this improvement in lipid profile in the rat group of Mangosteen-III Fruit Peel Ethanol Extract did not exceed the improvement shown in the standard group.

The anti-dislipidemia effect possessed by ethanol extract mangosteen peel can be related to the content of various phytochemicals in the mangosteen fruit. Several studies have shown the potential of phytochemicals as anti-dyslipidemia. Polyphenol content can cause down-regulation of pro-inflammatory cells signal modulation such as nuclear factor-xB, activated protein-1, and mitogen-activated protein kinase through the inhibition of the arachidonic acid cascade and eicosanoids derivates. Another mechanism that allows the anti-dyslipidemia effects of polyphenol compounds is the regulation of intestinal microbiota. Polyphenol compounds in the usu will interact with the gut microbiota thus increasing various beneficial metabolite products such as short-chain free fatty acids, in addition to usu microbes such as Akkermansia municiphilia sp. Restore inflammatory conditions in the intestines, improve intestinal permeability, and insulin sensitivity. Furthermore, this improvement to the gut microbiota protects the gut-liver axis thereby lowering lipid profiles in the body (Sun, Wang and Qin, 2018; Feldman et al., 2021).

Other studies discussing the anti-dyslipidemia effects of mangosteen peel ethanol are still limited. But, Dharmayanti (2018), who conducted a study on the Effects of Mangosteen Peel Ethanol Extract (Garcinia Mangostana.L) on LDL Levels in NIDDM Type Mice, reported that mangosteen peel extract provided an LDL reduction effect in NIDDM type mice (Dharmayanti, 2018). The diagnosis of dyslipidemia can be established based on increased ldl levels in the plasma. Xanthones found in the skin of mangosteen fruit are antioxidant, antidiabetic, anticancer, antiimflammatory, hepatoprotective, immunomodulation, aromatase inhibitor, antibacterial, also other functional, mangosteen fruit skin (Garcinia mangostana. L) is beneficial for health because it contains anthocyanins, tannins, phenol/polyphenol compounds, epicatekins, and xanthone (Supiyanti, Wulansari and Kusmita, 2010).

In addition, mangosteen peel ethanol extract also significantly lowered SGOT and SGPT levels compared to the control group. This decrease in SGOT and SGPT levels is

associated with improvement of Non-Alcoholic Fatty Liver Disease (NAFLD). Several studies have shown that NAFLD is a risk factor for arteriosclerosis. This is because NAFLD causes dysfunction of the endothelial blood vessels. Thong and Quynh (2021) report that both SGOT and SGPT correlate with the occurrence of NAFLD, but the use of SGOT and SGPT separately can indicate errors in confirming mild NAFLD. In the case of severe NAFLD, SGOT will increase slightly and in milder cases, SGOT levels can be found in normal amounts. Therefore, the use of SGOT and SGPT unilaterally may allow errors in confirming mild degree NAFLD (Thong and Quynh, 2021).

In this study, SGOT and SGPT levels in the group of mice that received mangosteen peel ethanol extract were lower than the levels of SGOT and SGPT from the control group. This suggests that mangosteen peel ethanol extract may protect liver tissue from NAFLD compared to the group that did not get mangosteen peel ethanol extract. However, the possibility of mild degree NAFLD in the group of mice that get mangosteen skin ethanol extract cannot be removed.

### V. Conclusion

The conclusion of this study, that ethanol extract mangosteen fruit peel significantly decreased total cholesterol, triglyceride levels, LDL levels, SGOT levels compared to the control group. Mangosteen peel ethanol extract can significantly increase HDL levels compared to the control group.

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