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The Use of Green Tea Extract (*Camellia sinensis*) Orally to Prevent Dyslipidemia in Female Rats (*Rattus norvegicus*) Fed A High-Fat Diet

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Abstract: One of the significant danger factors for cardiovascular disease and stroke is dyslipidemia. According to long-term prospective epidemiological research, coronary heart disease is less common in those with good lipid profiles who lead better lives. In this study, on a high-fat diet, female wistar rats (*Rattus norvegicus*) will be tested and analyzed to see if green tea extract (*Camellia sinensis*) can prevent dyslipidemia when given orally. Compared to a control group that received only distilled water, the trial group that received 5 milliliters of green tea extract (*Camellia sinensis*) had significantly lower total and LDL cholesterol levels and higher HDL cholesterol levels. This treatment was more effective in lowering cholesterol overall. The components found in green tea (*Camellia sinensis*), including tannins, steroids, alkaloids, saponins, and flavonoids, can induce this. When certain bioactive substances are off, the body can bring them back into normalcy. These results suggest that white wistar rats (*Rattus norvegicus*), given a high-fat diet, can benefit from green tea (*Camellia sinensis*) extract to avoid dyslipidemia. Your lipid profile can be improved by ingesting green tea extract. The primary polyphenol in tea, catechin, is responsible for this transformation. Therefore, the *Camellia sinensis* plant, from which green tea is made, is a valuable plant that can halt or slow the progression of several ailments, including hypertension, metabolic disorders, and cardiovascular disorders.

Keywords: Cholesterol; Dyslipidemia; Green tea; High-fat

Introduction

Developments have steadily changed human lifestyles. The convenience of working without moving reduces physical activity. This lack of exercise is often followed by increased calorie intake from energy-rich items like fast food (Saha et al., 2022). If this activity-energy imbalance continues, dyslipidemia will result (Yudin et al., 2022). Different scientific studies define dyslipidemia in different ways, but the idea is the same (Giner-Galvañ et al., 2016). Dyslipidemia is defined as unhealthy levels of one or more of the following types of lipid particles in the blood: High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL), Medium Density Lipoprotein (IDL), Very Low-Density Lipoprotein (VLDL), Triglycerides, Cholesterol, and others (Azis et al., 2019; Habte et al., 2016; Kopin & Lowenstein, 2017; Lin et al., 2018; Yudin et al., 2022).

Indonesia has an alarming dyslipidemia rate. According to Riskesdas (2019), 28.8% of Indonesians aged ≥15 have dyslipidemia, with total cholesterol levels above 200 mg/dL, LDL levels above 100 mg/dL, HDL levels below 40 mg/dL, and triglycerides above 150 mg/dL. A small population study (N 1,013) found that dyslipidemia (TC > 240 mg/dL) ranged from 9.0% to 25% among all ethnicities in Indonesia (Lin et al., 2018). Women had more dyslipidemia (Phan & Toth, 2014). Urban residents have more dyslipidemia than rural residents. Based on these statistics, Indonesia has a high dyslipidemia rate.

Our bodies use lipids as energy, cell membrane components, precursors of steroid hormones and fat-

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soluble vitamins, and more. Linoleic and linolenic acids, which the body cannot produce, are essential for proper biological functions. Understanding non-communicable diseases like hypertension, diabetes, cancer, cardiovascular disease, obesity, the nutritional significance of unsaturated fatty acids, and others requires knowledge of lipid biochemistry and metabolic disorders (dyslipidemia) (Habte et al., 2016). Coronary artery disease and stroke are linked to dyslipidemia. Long-term prospective epidemiological studies suggest that healthier lifestyles and better lipid profiles decrease coronary heart disease. Dyslipidemia prevention and management can significantly reduce cardiovascular mortality (Kopin & Lowenstein, 2017). A 5-year multicenter retrospective cross-sectional study by Méndez-Sánchez et al. (2018) found that dyslipidemia is a prevalent risk factor for advanced liver disease and cirrhosis.

Genetic and environmental risk factors modulate multifactorial dyslipidemia (Gomez-Quiroz & Roman, 2022; Mendonça et al., 2023; Mosca et al., 2022; Vasyutina et al., 2022). Lipid levels might rise from confident lifestyle choices. Tobacco, exercise, nutrition, and obesity are examples. Eating too little fruit, nuts/seeds, veggies, or saturated fats is a nutritional risk factor. Lifestyle changes, including poor diet and exercise, are substantially linked to excess adiposity regardless of heredity (Oliosa et al., 2019). Genetics can cause dyslipidemia, but risky lifestyles or chronic diseases cause most cases—lifestyle management matters (Brown et al., 2020).

Pharmacological and non-pharmacological treatments are available for dyslipidemia. Non-pharmacological techniques involve lifestyle changes. Lifestyle changes can improve total cholesterol, HDL-C, LDL-C, and triglycerides. Healthy lifestyle changes include a heart-healthy diet, frequent exercise, avoiding tobacco, and keeping a healthy weight (Kopin & Lowenstein, 2017). Pharmacological implies taking hypolipidemic. Indonesian dyslipidemia patients can use statins, ezetimibe, bile acid sequestrant, fibrates, nicotinic acid, and cholesteryl ester transfer protein inhibitors (Pappan & Rehman, 2023). Herbal remedies are more popular because medications might produce unwanted effects. Drinking green tea is one.

Giglio et al. (2018) recommend green tea as a health supplement. Ancient and modern civilizations have used tea for its health-promoting, mental health-promoting, refreshing, and social-cultural impacts. People are more health-conscious now, and tea consumption is changing (Giglio et al., 2018). Tea is becoming a functional beverage because it can prevent cardiovascular disease, metabolic disease, neurological damage, gastrointestinal issues, and cancer. In addition, tea polyphenols may soon be employed as chemo preservatives in cancer treatment. Regular tea consumption is a new health strategy for physical and mental health (Samanta, 2020; Yao et al., 2021; Yassin et al., 2022). Asia grows the most popular drink, green tea (Yu et al., 2019). Unlike soft beverages and alcohol, green tea can calm its admirers (Amin et al., 2023). It comes in packets. Loose-leaf, quick powder, and pill supplements are sold. There are three main tea varieties based on processing. However, green tea is not fermented or oxidized. Catechins are reduced by tea leaf fermentation. However, green tea has the most catechins. The major catechin components are epicatechin (EC), epigallocatechin (EGC), epicatechin gallate (ECG), and epigallocatechin-3-0-gallate (EGCG) (Azis et al., 2019).

Green tea or its extract prevents chronic diseases, including cardiovascular disease (Akter et al., 2023; Katanasaka et al., 2020; Wagner et al., 2021). Dyslipidemia and obesity are major CVD risk factors. Green tea boosts hepatic lipid metabolism, inhibits gastric and pancreatic lipase, increases thermogenesis, modulates hunger, synergizes with caffeine and theanine, and suppresses fatty acid production (Azis et al., 2019). Based on the stated occurrences, this study aimed to test and analyze the effectiveness of oral administration of green tea (*Camellia sinensis*) extract in preventing dyslipidemia in female wistar rats (*Rattus norvegicus*) given a high-fat diet. This phenomenon is supported by several previous research results, with the study finding that in mice fed an atherogenic diet, supplementation with green tea extract in food could reduce cardiovascular risk factors, including dyslipidemia (Amin et al., 2023; Chiva-Blanch & Badimon, 2017; Giglio et al., 2018; Yang et al., 2001; Yu et al., 2019). Human studies show that EGCG improves lipid profiles. The mechanism may involve reduced lipid absorption, suppression of lipogenesis, and inflammation reduction (Yuan et al., 2018).

Method

This research is experimental quantitative research employing an actual experiment or laboratory experimental design. Taking empirical research seriously means controlling all external variables that can affect it (Notoatmodjo, 2022). This pre-test–post-test control group study examined the effects of oral green tea (*Camellia sinensis*) on dyslipidemia in high-fat-fed female Wistar rats (*Rattus norvegicus*). This study used female Wistar rats (*Rattus norvegicus*) weighing 160-200 gr and aged 2-3 months. Kendall et al. (2018) employed the 3R Principle (Replacement, Reduction, and Refinement) to determine the number of study samples.

All 20 male wistar rats will be placed into four groups for the study. Each group had five mice.

The variables in this research consist of independent variables and dependent variables (Suwarno & Nugroho, 2023). The independent variable in this research is green tea extract (*Camellia sinensis*). Meanwhile, the dependent variable is dyslipidemia, including lipid fraction levels: Total cholesterol, LDL cholesterol, and HDL cholesterol. In this study, researchers used tools such as rat drums, gloves, cannulas, vials, porcelain cups, digital scales, sondes, markers, blenders, pipettes, EDTA tubes, feed containers, rotary evaporators, ovens, micropipettes, filter paper. Whatman No.2, Eppendorf tube, and mask. The ingredients include Wistar strain female rats, distilled water, 96% ethanol, high-fat feed, and green tea (*Camellia sinensis*) extract.

Acclimatizing test animals for seven days at the Animal House, Faculty of Mathematics and Natural Sciences, Medan State University, was the initial study step. Then, we will produce green tea extract (*Camellia sinensis*) and a phytochemical test (tannin, flavonoid, alkaloid, and steroids). Feed mice a high-fat, high-cholesterol meal daily to prepare the test animals. The feed is quail egg yolk. These foods exogenously raise cholesterol and obesity. High-fat, high-cholesterol diets were given for 14 days before green tea extract treatment.

Procedure After seven days of acclimatization, mice were randomly assigned into four groups for treatment. Five mice per group received standard pellets and green tea (*Camellia sinensis*) extract for 28 days. Control Group (P-0) mice received pellets and distilled water daily. In Treatment Group-1 (P-1), mice received daily pellet food and 3 ml of extract. In Treatment Group-2 (P-2), mice received a pellet diet and 4 ml of extract daily. In Treatment Group-3 (P-3), mice received daily pellet food and 5 ml of extract. Posttests measured total, LDL, and HDL cholesterol after 28 days of treatment. The research data was analyzed using SPSS 25.0 for Windows. The Kolmogorov-Smirnov test ($p > 0.05$) assessed data normality. The significance between groups was tested using a one-way analysis of variance (One-way ANOVA) with a 95% confidence level ($p < 0.05$) (Ghozali, 2018). The Post Hoc Test with LSD was used for further analysis.

Result and Discussion

Result

White wistar rats (*Rattus norvegicus*) have typical cholesterol levels of 10-54 mg/dl (Smith & Mangkoewidjojo, 1988). Cholesterol > 54 mg/dl is high. Researchers observed that mice fed a high-fat egg yolk diet had higher overall cholesterol levels. After a high-fat diet, the control group's cholesterol rose from 52.02 to 59.42 mg/dl. Treatment group 1's cholesterol rose from 52.2 to 59.38 mg/dl following 14 days of a high-fat diet. Treatment group 2 started with 52.48 mg/dl cholesterol and climbed to 59.2 mg/dl, whereas the last group started with 52.92 mg/dl and increased to 59.16 mg. After a high-fat meal raised the mice's total cholesterol, researchers gave them varied doses of distilled water and green tea extract. Table 2 shows mice's total cholesterol levels following 28 days of green tea extract (*Camellia sinensis*) therapy. The researchers rechecked each animal's total cholesterol. The table above shows that total cholesterol levels decreased in each group. The control group had high total cholesterol or dyslipidemia since their initial cholesterol level was 59.42 mg/dl and reduced to 56.62 mg/dl after being given distilled water.

Table 1. Characteristics of Test Animals

Component	Group K	Group P1	Group P2	Group P3
Types of Rats	*Rattus norvegicus*			
Gender	Female			
Condition	White fur, healthy and active			
Initial B/W	260 gr	265 gr	267 gr	267 gr
Final B/W	250 gr	240 gr	222 gr	201 gr

Table 2. Total Cholesterol Levels in Mice

Group	Repetition	Daily Cholesterol Levels (mg/dl)		
		Day 0	Day 14	After Treatment
Control Group (P-0)	1st	52.7	60.2	57.5
	2nd	51.3	59.5	56.1
	3rd	50.2	58.6	55.6
	4th	52.8	58.7	55.8
	5th	53.1	60.1	58.1
	Mean	52.02	59.42	56.62
Treatment Group-1 (P-1)	1st	51.5	58.7	53.2
	2nd	52.9	59.8	52.8
	3rd	51.9	59.6	53.2
	4th	53.5	58.3	52.4
	5th	51.2	60.5	53.1
	Mean	52.2	59.38	52.94
Treatment Group-2 (P-2)	1st	52.1	58.9	51.2
	2nd	53.6	59.6	51.7
	3rd	53.8	58.8	50.8
	4th	51.2	59.3	50.2
	5th	51.7	59.4	51.3
	Mean	52.48	59.2	51.04
Treatment Group-3 (P-3)	1st	53.2	58.6	49.2
	2nd	51.4	59.9	48.3
	3rd	55.7	59.4	49.4
	4th	51.6	57.3	49.5
	5th	52.7	60.6	50.1
	Mean	52.92	59.16	49.3

White wistar rats (*Rattus norvegicus*) have typical cholesterol levels of 10-54 mg/dl (Smith & Mangkoewidjojo, 1988). Cholesterol > 54 mg/dl is high. Researchers observed that mice fed a high-fat egg yolk diet had higher overall cholesterol levels. After a high-fat diet, the control group's cholesterol rose from 52.02 to 59.42 mg/dl. Treatment group 1's cholesterol rose from 52.2 to 59.38 mg/dl following 14 days of a high-fat diet. Treatment group 2 started with 52.48 mg/dl cholesterol and climbed to 59.2 mg/dl, whereas the last group started with 52.92 mg/dl and increased to 59.16 mg. After a high-fat meal raised the mice's total cholesterol, researchers gave them varied doses of distilled water and green tea extract. Table 2 shows mice's total cholesterol levels following 28 days of green tea extract (*Camellia sinensis*) therapy. The researchers rechecked each animal's total cholesterol. The table above shows that total cholesterol levels decreased in each group. The control group had high total cholesterol or dyslipidemia since their initial cholesterol level was 59.42 mg/dl and reduced to 56.62 mg/dl after being given distilled water.

Treatment group 1 received 3ml of green tea (*Camellia sinensis*) extract, which reduced levels from 59.38 to 52.94 mg/dl. Treatment group 2 decreased from 59.2 to 51.04 mg/dl, while treatment group 3 decreased the most, from 59.16 to 49.3 mg. According to the data, the group administered green tea (*Camellia sinensis*) extract had lower total cholesterol levels (< 54 mg/dl) and no longer had dyslipidemia. Still, the control group had 56.62 or > 54 mg/dl cholesterol. The second parameter is an examination of test animals' blood serum LDL levels to see the condition of dyslipidemia in mice. Normal LDL levels in mice are 7-27.2 mg/dl; it is considered high if it reaches > 27.2 mg/dl. The Table 3 shows mice's LDL levels before and after being given a high-fat diet.

Table 3 shows that high-fat diets raised LDL in mice. A high-fat diet increased the control group's LDL level from 19.6 to 29.66 mg/dl. After a day of high-fat diet, treatment group 1's LDL cholesterol jumped to 29.4 mg/dl from 19.76 mg/dl. Treatment group 2 had 19.9 mg/dl LDL levels that rose to 29.58 mg/dl, while treatment group 3 had 19.6 mg/dl LDL levels that rose to 29.56 mg/dl. Researchers decided that the test animals had dyslipidemia since their LDL levels were > 27.2 mg/dl. After eating a high-fat diet, rats was given distilled water and green tea (*Camellia sinensis*) extract for 28 days to examine if it reduced LDL levels.

After 28 days of green tea extract administration, researchers examined each rat's LDL levels again. LDL levels decreased in each group, as shown in the table above. The control group given distilled water had high LDL levels or dyslipidemia since their initial LDL level was 29.1mg/dl and climbed to 28.62 mg/dl after eating a high-fat diet. Green tea extract at 3ml decreased from 29.9 to 25.8 mg/dl in treatment group 2. Treatment group 2 received 4 ml of green tea extract and saw a decrease from 29.58 to 23.76 mg/dl. Treatment group 3 received 5 ml and declined from 29.56 to 21.8 mg/dl. Results indicate that the group administered green tea (*Camellia sinensis*) extract had lower LDL levels (< 27.2 mg/dl) and no longer had elevated or dyslipidemia. The control group had high LDL values (> 27.2 mg/dl).

Table 3. Total LDL Levels in Mice

Group	Repetition	Daily Cholesterol Levels (mg/dl)		
		Day 0	Day 14	After Treatment
Control Group (P-0	1st	20.3	30.1	29.2
	2nd	19.9	30.2	28.9
	3rd	19.5	29.9	28.7
	4th	19.1	28.9	27.8
	5th	19.2	29.2	28.5
	Mean	19.6	29.66	28.62
Treatment Group-1 (P-1)	1st	18.8	29.1	26.7
	2nd	20.2	29.4	25.8
	3rd	19.7	29.3	26.3
	4th	18.8	30.1	24.3
	5th	21.3	29.1	25.9
	Mean	19.76	29.4	25.8
Treatment Group-2 (P-2)	1st	20.8	30.2	23.4
	2nd	21.4	29.5	24.5
	3rd	19.2	30.9	23.2
	4th	19.6	28.4	24.8
	5th	18.5	28.9	22.9
	Mean	19.9	29.58	23.76
Treatment Group-3 (P-3)	1st	19.3	29.1	21.9
	2nd	18.7	30.6	22.5
	3rd	19.7	30.3	21.7
	4th	19.6	29.6	22.4
	5th	20.7	28.2	20.5
	Mean	19.6	29.56	21.8

Next, HDL levels drop. The inbred strains' HDL-cholesterol normal levels vary from 35 to 172 mg/dl (Schaefer et al., 1994; Svensson & Friberg, 2007). High-fat diets decreased HDL levels in mice, as shown in Table 4. HDL levels dropped from 50.62 to 29.29 mg/dl in the control group after eating a high-fat meal. In treatment group 1, HDL cholesterol dropped from 50.54 to 29.02 mg/dl after a day of high-fat food. Group 2 had 51.12 mg/dl LDL levels, which fell to 29.02 mg/dl, while group 3 had 50.72 mg/dl LDL levels, which dropped to 29.16 mg/dl. Researchers identified dyslipidemia in test animals due to low HDL levels (< 35 mg/dl). After eating a high-fat diet, rats was given distilled water and green tea (*Camellia sinensis*) extract for 28 days to examine if it raised HDL levels.

Table 4. Total HDL Levels in Mice

Group	Repetition	Daily Cholesterol Levels (mg/dl)		
		Day 0	Day 14	After Treatment
Control Group (P-0)	1st	50.1	50.1	30.4
	2nd	51.4	51.4	30.5
	3rd	49.8	49.8	29.9
	4th	50.6	50.6	30.1
	5th	51.2	51.2	29.9
	Mean	50.62	29.292	30.16
Treatment Group-1 (P-1)	1st	50.6	50.6	36.1
	2nd	50.8	50.8	37.5
	3rd	52.1	52.1	36.8
	4th	49.7	49.7	37.2
	5th	49.5	49.5	38.3
	Mean	50.54	29.02	37.18
Treatment Group-2 (P-2)	1st	51.6	51.6	39.5
	2nd	50.8	50.8	39.7
	3rd	51.8	51.8	38.6
	4th	50.2	50.2	39.1
	5th	51.2	51.2	38.5
	Mean	51.12	29.02	39.08
Treatment Group-3 (P-3)	1st	50.2	50.2	42.6
	2nd	51.4	51.4	42.9
	3rd	50.1	50.1	42.7
	4th	52.1	52.1	41.9
	5th	49.8	49.8	42.3
	Mean	50.72	29.16	42.48

After 28 days of green tea extract administration, researchers examined each mouse's HDL levels again. Each group's HDL levels increased, as shown in the table above. The control group given distilled water had low HDL levels or dyslipidemia since their beginning HDL level was 29.29 mg/dl and rose to 30.16 at the end of the high-fat diet. Green tea extract at 3ml increased from 29.02 to 37.18 mg/dl in treatment group 2. Treatment group 2 received 4ml of green tea extract and increased from 29.02 to 39.08 mg/dl, whereas treatment group 3 received 5 ml and increased from 29.16 to 42.48 mg/dl. The group administered green tea extract no longer had low HDL levels or dyslipidemia because HDL values were > 35 mg/dl. Meanwhile, the control group maintained high HDL levels (< 35 mg/dl). Green tea extract phytochemical testing follows. Phytochemical studies were performed in high-fat-fed white wistar rats (*Rattus norvegicus*) to see if green tea extract components may lower cholesterol and LDL and raise HDL. Overall, test findings were positive, including flavonoids yielding a red extract and alkaloids yielding a yellow extract. Researchers observed foam in green tea extract, indicating saponins. Green indicates steroid presence in the steroid test. If the tannin test findings show a green-black liquid, green tea extract includes tannin.

Based on the Kolmogorov-Smirnov normality test results in Table 5, all post-test data and pre-test data had significance values of 0.200. A p-value > 0.05 indicates regularly distributed data. Thus, pre-and post-test data are periodically distributed. After confirming that the data is normally distributed, the Levene test assesses if each variety of the study population group is homogeneous.

Table 5. Normality Test Results of Total Cholesterol

	Tests of Normality			
	Kolmogorov-Smirnov[a]			
	Group	Statistic	df	Sig.
Pre-Test Total	Control	.231	5	.200*
	Treatment P1	.199	5	.200*
	Treatment P2	.216	5	.200*
	Treatment P3	.175	5	.200*
Pre-Test Total	Control	.280	5	.200*
	Treatment P1	.279	5	.200*
	Treatment P2	.211	5	.200*
	Treatment P3	.239	5	.200*

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on Table 6, the result of the Kolmogorov-Smirnov normalcy test results, the total LDL, both pre- and post-tests had significant values of 0.200 and 0.161. A p-value > 0.05 indicates regularly distributed data. Thus, pre-and post-test data are periodically distributed. After confirming that the data is normally distributed, the Levene test assesses if each variety of the study population group is homogeneous.

Table 6. Normality Test Results Total LDL

	Tests of Normality			
	Kolmogorov-Smirnov[a]			
	Group	Statistic	df	Sig.
Pre-Test Total	Control	.261	5	.200*
	Treatment P1	.300	5	.161
	Treatment P2	.152	5	.200*
	Treatment P3	.179	5	.200*
Pre-Test Total	Control	.210	5	.200*
	Treatment P1	.300	5	.161
	Treatment P2	.266	5	.200*
	Treatment P3	.250	5	.200*

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 7. Normality Test Results Total HDL

	Tests of Normality			
	Kolmogorov-Smirnov[a]			
	Group	Statistic	df	Sig.
Pre-Test Total	Control	.230	5	.200*
	Treatment P1	.230	5	.200*
	Treatment P2	.309	5	.133
	Treatment P3	.218	5	.200*
Post-Test Total	Control	.224	5	.200*
	Treatment P1	.148	5	.200*
	Treatment P2	.217	5	.200*
	Treatment P3	.221	5	.200*

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 7 shows Kolmogorov-Smirnov normalcy test results and the total HDL. All post-test data and pre-test data had significance values of 0.200. A p-value > 0.05 indicates regularly distributed data. Thus, pre-and post-test data are periodically distributed. After confirming that the data is normally distributed, the Levene test assesses if each variety of the study population group is homogeneous.

Table 8. Homogeneity Test Cholesterol, LDL & HDL

Test of Homogeneity of Variances					
Base on Mean		Levene Statistic	df1	df2	Sig.
Pre-Test	Cholesterol	2.274	3	16	.119
	LDL	1.723	3	16	.202
	HDL	1.373	3	16	.287
Post-Test	Cholesterol	4.041	3	16	.026
	LDL	.489	3	16	.695
	HDL	.143	3	16	.933

Table 8 shows the results of the Homogeneity of Variance Tests for cholesterol, LDL, and HDL. The cholesterol test results in the significant pre-test column were 0.119 and post-test 0.026. The LDL test results in the significant pre-test column are 0.202 and the post-test 0.695. The HDL test results in the significant pre-test column are 0.287 and the post-test 0.933. The control group, treatment group 1, treatment group 2, and treatment group 3 pre-test and post-test data originate from populations with the same variance or both groups because the significance probability value is more than 0.05. They are used for one-way ANOVA testing.

Table 9. ANOVA Test Cholesterol, LDL & HDL

ANOVA Test						
Between Group		Sum of Square	df	Mean Square	F	Sig.
Pre-Test	Chol	.250	3	.083	.109	.954
	LDL	.178	3	.059	.098	.960
	HDL	.256	3	.085	.182	.907
Post-Test	Chol	147.686	3	49.229	93.635	.000
	LDL	127.609	3	42.536	69.447	.000
	HDL	404.861	3	134.954	457.859	.000

Table 9 shows the one-way ANOVA test on total cholesterol, LDL, and HDL. The cholesterol test results produced a significance value of 0.954 in the pre-test data and 0.000 in the post-test data or > 0.05. The results of the LDL test produced a significance value of 0.960 in the pre-test data and 0.000 in the post-test data or > 0.05. The results of the HDL test produce a significance value of 0.907 in the pre-test data and 0.000 in the post-test data or > 0.05. Pre-test data showed no significant differences in total cholesterol, LDL, and HDL levels between the control and treatment groups. Post-test data or after different treatments for each group showed quite significant differences between the test groups. The LSD post-hoc test follows the post-test results.

Table 10. Cholesterol, LDL & HDL Post Hoc Test Results

Group		Mean Difference			Sig.		
(I)	(J)	Chol	LDL	HDL	Chol	LDL	HDL
Cont	P1	.45858	.49497	.45858	.000	.000	.000
	P2	.45858	.49497	.45858	.000	.000	.000
	P3	.45858	.49497	.45858	.000	.000	.000
P1	Cont	.45858	.49497	.45858	.000	.000	.000
	P2	.45858	.49497	.45858	.001	.001	.001
	P3	.45858	.49497	.45858	.000	.000	.000
P2	Cont	.45858	.49497	.45858	.000	.000	.000
	P1	.45858	.49497	.45858	.001	.001	.001
	P3	.45858	.49497	.45858	.002	.001	.001
P3	Cont	.45858	.49497	.45858	.000	.000	.000
	P2	.45858	.49497	.45858	.000	.000	.000
	P3	.45858	.49497	.45858	.002	.001	.001

*. The mean difference is significant at the 0.05 level.

The cholesterol, LDL, and HDL Post Hoc tests determine whether groups differ significantly from other groups. The results of the Post Hoc test analysis in this study showed significance values of 0.000, 0.001, and 0.002 or smaller than 0.05, which means that the control and treatment groups had significant differences.

Discussion

Tests of green tea (*Camellia sinensis*) extract to prevent dyslipidemia in high-fat-fed white wistar rats (*Rattus norvegicus*). Twenty wistar white rats (*Rattus norvegicus*) were separated into four groups for this study. The control group received distilled water, Treatment Group 1 received 3ml green tea extract, Treatment Group 2 received 4ml, and Treatment Group 3 received 5ml. Before receiving green tea extract (*Camellia sinensis*), mice in the control group weighed 260 grams, treatment groups 1 and 2 265 grams, and treatment groups 3 267 grams. After day 28, the mice were weighed again, and each group had different average findings. Control 250 grams, treatment 1 230 grams, treatment 2 222 grams, and last 201 grams. These findings show that all test groups lost weight, but treatment group 3 lost the most, 66 grams.

After receiving a high-fat diet of quail egg yolk for 14 days, the animals were divided into four groups for different treatments: one control group received only distilled water, while the other three received green tea extract preparations at different doses. Researchers used total cholesterol, LDL, and HDL to diagnose mice with dyslipidemia. An imbalance in this lipid profile is dyslipidemia. Dyslipidemia harms blood levels of HDL, LDL, IDL, VLDL, triglycerides, cholesterol, and others. Lipoprotein metabolism disorders cause dyslipidemia, which can be excess or hypolipoproteinemia. Decreased HDL and increased total and LDL cholesterol indicate dyslipidemia (Habte et al., 2016).

A simple blood test for LDL, HDL, and total cholesterol can detect dyslipidemia. The results will show high, low, or healthy blood fat levels. Dyslipidemia results from three fat fraction imbalances. Green tea extract can enhance the lipid profile and cure this illness before it worsens. This alteration is induced by catechin, the primary tea polyphenol. The *Camellia sinensis* plant produces green tea, which helps delay the onset of cardiovascular, metabolic, and hypertensive illnesses. Tea polyphenols, notably catechins (flavonoids), improve health. Based on the benefits of green tea (*Camellia sinensis*) extract, researchers want to test its ability to lower total and LDL cholesterol and raise HDL levels in high-fat-fed white rats wistar strain.

This 14-day observation approach yielded data that needed processing and testing, requiring various data analyses. First, data is processed and normality tested. The Kolmogorov-Smirnov test in SPSS determined normality. All test groups had normally distributed pre- and post-test data on total cholesterol, LDL, and HDL levels with a significance value > 0.05. Thus, the data is regularly distributed or represents the population. The Levene test determines if normally distributed data originates from a population with the same variance. Pre- and post-test total cholesterol, LDL, and HDL levels had significance values > 0.05. The control, treatment 1, and therapy three groups are homogeneous or from the same population for each parameter since the significant probability value is greater than 0.05. One-way ANOVA assessed this customarily distributed and homogeneous data for efficacy and significance.

The One-way ANOVA test showed that all post-test groups had 0.000 or greater than 0.05 significant values for total cholesterol, LDL, and HDL. Based on these results, a follow-up post-hoc LSD test is needed because the post-test data differs significantly between the control group, treatment group 1, treatment group 2, and treatment group 3. A post-hoc LSD test was used to compare the group's average total cholesterol, LDL, and HDL. The Post Hoc LSD test analysis in this study revealed significant differences between all groups (p-value < 0.05). The experimental group that received green tea extract (*Camellia sinensis*) had lower total cholesterol, LDL, and HDL cholesterol than the distilled water group. Green tea extract (*Camellia sinensis*) contains flavonoids, alkaloids, saponins, steroids, and tannins. These bioactive substances normalize lipid profiles. This suggests that green tea (*Camellia sinensis*) extract prevents dyslipidemia in high-fat-fed white wistar rats (*Rattus norvegicus*).

Conclusion

Past studies have shown that extract from green tea (*Camellia sinensis*) can protect male wistar white rats (*Rattus norvegicus*) from developing dyslipidemia by lowering total and LDL cholesterol levels and raising HDL levels in response to a high-fat diet. Regarding reducing total and LDL cholesterol levels while increasing HDL levels, 5 milliliters of green tea extract is optimal. The total cholesterol levels in the group that received 5 milliliters of green tea extract went from 59.16 milligrams per deciliter to 49.3 milligrams per deciliter before and after the treatment. LDL values ranged from 29.56 mg/dl before therapy to 21.8 mg/dl after treatment. Before and following therapy, HDL levels went from 29.16 to 42.48 mg/dl. The One-Way ANOVA test indicates a significance level lower than 0.05 (0.000). It is clear from these numbers that the treatment group differs significantly from the control group. A significance value less than 0.05 was shown by the Post Hoc LSD test analysis in this study, indicating that there were significant differences between all groups. If we want to know how green tea extract affects HDL, LDL, and total cholesterol levels in humans, we need to conduct human studies in the future. Then, we can see if it is a viable alternative medicine for lowering bad cholesterol and increasing good cholesterol. A comprehensive analysis of the chemical composition of green tea extract was also conducted to identify additional components that have yet to be investigated. A comprehensive lipid profile analysis is also required to bolster the research findings.

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Authors Contributions
Christina J. R. Esmaralda Lumbantobing conceptualized the research idea, designed of methodology, management and coordination responsibility; Risna Damayanti analyzed data, conducted a research and investigation process; Liena conducted literature review and provided critical feedback on the manuscript.

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The authors declared no conflict of interest.

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