# Test Of The Effectiveness Of Oral Administration Of Red Dragon Fruit (*Hylocereus Polyrhizus*) In Preventing Dyslipidemia In Male Wistar Rats (*Rattus Norvegicus*) Given A High High-Cholesterol Diet

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***Abstract.***

*Hyperlipidemia can result from obesity, which causes excess fat to build in the tissue under the skin and spread to other organs and tissues. Indonesia has an alarming dyslipidemia rate. Diet and exercise are vital. Hypolipidemia is in red dragon fruit (Hylocereus spp.) The study examined whether oral red dragon fruit extract prevented dyslipidemia in male Wistar rats (Rattus norvegicus) fed a high-cholesterol diet. This research used 24 mice as test animals. The research procedures included acclimation of the test animals, dragon fruit extract, phytochemical tests, preparation of the test animals, treatment with four groups, dyslipidemia parameter checks, histopathological preparations, and observations. Normal tests for total cholesterol, LDL, LSD, and HDL yielded p-values> 0.05. Homogeneity tests with a 5% significance level yielded p values < 0.05. This study's one-way Anova test yields a significance value of 0.000, or <0.05, whereas the post-hoc LSD test yields <0.05. The best red dragon fruit extract dose for lowering total and LDL cholesterol and raising HDL is 120 mg/mL. The phytochemical experiments on red dragon fruit extract (Hylocereus polyrhizus) show promise for improving the lipid profile.*

***Keywords:*** *Red Dragon Fruit, Dyslipidemia, and Cholesterol, Obesity.*

## I. INTRODUCTION

Food and water are the building blocks and primary energy sources for the human body. We get all the energy we require from food. As a result, food is crucial to human existence. Nutrients are supplied to the human body through food consumption. Humans need Energy constantly, whether running, leaping, or even sleeping, and it is obtained from food. Nutrients included in food also build up the structural components of the human body, including bones, muscles, and organs. Therefore, it is crucial for human survival to consume and absorb nutrients, which serve as energy sources and eventually become part of our body's structural makeup [1].Fast food and meal delivery services have become ubiquitous in modern life. This is because technology is advancing at a rapid pace. Thanks to technological advancements, several formerly inaccessible industries are now within easy reach, including online meal ordering and delivery. Fast food, in particular, is notorious for having unhealthy levels of calories, fat, sugar, salt, and other additives. The percentage of Indonesians getting the required amount of fruits and vegetables still needs to be higher, at 63.3%. The likelihood of being overweight or obese will rise due to these factors, raising body mass index [2].Excess fat builds up in the subcutaneous tissues and eventually spreads to other parts of the body, causing the medical condition known as obesity. Obesity, from a health perspective, is a nutritional deficit brought on by the chronic overconsumption of bad foods. Elevated total cholesterol levels (> 200 mg/dL) are among the health issues experienced by obese persons [3].

An imbalance in the lipid profile, known as dyslipidemia, affects an estimated 60 to 70% of obese people, according to the research. Increased triglyceride (TG) levels and reduced high-density lipoprotein (HDL) levels are the critical hallmarks of dyslipidemia, which is further contributed to by worsened insulin resistance [4].When lipids like cholesterol, LDL-C, triglycerides, and HDL levels are out of whack, the condition is known as dyslipidemia (HDL). For energy synthesis, steroid creation, or bile acid formation, the

body absorbs lipids from the stomach and transports them throughout the body via lipoproteins. Triglycerides, cholesterol, low-density lipoprotein cholesterol (LDL-C), and HDL are the primary factors that contribute to this (HDL). Dyslipidemia can result from an imbalance of these components, which either organic or non-organic reasons can cause. Diet, cigarette use, or heredity are all potential causes of dyslipidemia, which in turn increases the risk of cardiovascular disease and its devastating consequences[5].An increasing number of cases of dyslipidemia have been reported in Indonesia. [6] found that among Indonesians aged 15 and above, about 28.8% had total cholesterol levels over 200 mg/dL, 72.8% had LDL levels above 100 mg/dL, 24.4% had HDL levels below 40 mg/dL, and 27.9% had triglyceride levels above 150 mg/dL, indicating a prevalence of dyslipidemia. These results suggest that dyslipidemia is prevalent in Indonesia.An easy way to determine whether someone has dyslipidemia is to undergo a blood test that evaluates triglycerides, HDL, and LDL.

One of the primary functions of LDL in plasma is to transport cholesterol [7]. One way HDL could be anti-atherogenic is by reversing the movement of cholesterol from peripheral tissues to the liver, a process in which it plays a significant role. This capacity to suppress atherosclerosis may be aided by HDL particles' anti-oxidant, anti-inflammatory, anti-thrombotic, and anti-apoptotic characteristics [8]. Triglycerides are the primary dietary fats found in plants and animals and the primary fats stored in the body [9]. Examining your LDL, HDL, and triglyceride levels may determine if your blood fat levels are high, low, or normal. The condition known as dyslipidemia occurs when the three types of lipids are out of whack. Another way to determine if someone has dyslipidemia is to look at their hsCRP (C-Reactive Protein) levels [10].Inflammation causes the levels of C-reactive protein (CRP), a pentameric protein produced by the liver, to rise. In the early stages of an infection or inflammation, interleukin (IL)-6 acts on the CRP-coding genes to stimulate the production of CRP, an acute-phase reactant protein [10]. Hypercholesterolemia (HDL) is associated with elevated hs-CRP levels in the general population [11]. Therefore, hs-CRP can be utilized as a biomarker to assess dyslipidemia progression. Serum cholesterol, triglyceride, or associated lipoprotein species levels that are abnormally high or low constitute dyslipidemia. Atherosclerotic cardiovascular disease (ASCVD) is the most common clinical outcome of dyslipidemia. Low HDL-C levels characterize this condition, raised total and LDL cholesterol (C), and elevated triglycerides (TG) and lipoprotein (a) (Lp(a)). Obesity and type 2 diabetes, which are secondary risk factors, are frequently prevalent.

Rare dyslipidemia can have additional clinical repercussions, such as pancreatitis with high TG levels, hepatosteatosis, and fat-soluble vitamin insufficiency in people whose genes prevent them from making enough apolipoprotein (apo)B-containing lipoproteins [12].Although dyslipidemia often causes no symptoms, it can increase the risk of developing vascular diseases that might manifest as symptoms, such as coronary artery disease, cerebrovascular disease, and peripheral arterial disease (Taha et al., 2021). The prevalence of dyslipidemia is a significant factor in the worldwide burden of cardiovascular disease. Circulating LDL-C and other ApoB-carrying lipoproteins play a crucial role in the development of atherosclerosis, according to consistent data from epidemiologic and clinical investigations. Thus, lipid treatment for primary and secondary prevention of cardiovascular disease and recurrent cardiovascular events mainly entails lowering LDL-C and other ApoB-containing lipoproteins[13].Getting the word out about the dangers of dyslipidemia, high cholesterol, and methods for lowering blood cholesterol levels requires extra effort. Modifications to the patient's lifestyle, such as their eating habits (lower saturated and trans-fat, more fiber, and fewer calories overall; for obese patients, stanol supplements may be helpful), smoking habits, and exercise routines, can frequently alleviate cholesterol levels [14].Increasing daily energy expenditure to improve energy balance is an excellent technique for conquering dyslipidemia. The more negative the energy balance, the higher the weight loss.

Increasing physical activity, whether at work, around the house, or in one's own time, is a great way to maximize energy expenditure. The breakdown of the body's primary energy reserves, glycogen and triacylglycerol, is accelerated by physiological and cellular mechanisms that increase energy expenditure, leading to weight loss. Physical activity speeds up several metabolic processes, including glycogenolysis, citric acid cycle, oxidative phosphorylation, lipolysis (in both muscle and adipose tissue), and fatty acid oxidation (in muscle) [15].The health advantages of physical activity are numerous, both in the short and

long term. Anxiety, poor sleep quality, and hypertension can all be temporarily alleviated with as little as one session of moderate to strenuous exercise. Consistent physical exercise has long-term protective effects against mental health issues, cognitive decline, cardiovascular disease, stroke, diabetes, cancer, excess body fat, and osteoporosis [16]. Strict calorie and cholesterol-restricted diets, frequent exercise, and lifestyle control are the cornerstones of reversing dyslipidemia [17]. There are natural alternatives to pharmaceuticals that can treat dyslipidemia and its symptoms without creating any unwanted side effects.

The red dragon fruit plant is one of several plants with hypolipidemic properties that have been the subject of research [18].The pitaya, or dragon fruit, is a member of the cactus family (Hylocereus spp.). Cultivated worldwide in tropical and subtropical climates, it is exotic, nutritious, and delicious. Dragon fruit is an excellent source of several nutrients, including vitamins, polyphenols, carbohydrates, amino acids, and betalain colors [19]. Overlapping green fins cover the fruit of the dragon fruit, which has a vibrant crimson skin. Because there is much genetic variation across fruit species, each has its unique form, skin, pulp color, number of thorns, and more [20]. Due to its high levels of phenolic and betasianin compounds, dragon fruit is considered to have biological activity. [21], the presence of specific components in dragon fruit makes it a potential remedy for stress- and inflammation-related diseases. As a preventative measure, it should be suggested to decrease blood pressure, diabetes, and gastrointestinal issues. The genus Hylocereus, which includes dragon fruit, may help ward off inflammatory and oxidative stress-related illnesses [22]. This is why dyslipidemia is one of the ailments that dragon fruit can assist with. This study aims to determine whether male Wistar rats with a high-cholesterol diet have dyslipidemia when given red dragon fruit extract. Studies on how healthy red dragon fruit peel improved lipid profiles in dyslipidemia provide credence to this study. The findings of this study suggest that dragon fruit peel extract may be an alternative to traditional lipid-lowering treatments for dyslipidemia [23]. Researchers in this study went above and beyond by including hsCRP testing and offering swimming as an extra therapy to rats given a high-cholesterol diet to alter their lipid profiles.

## II. METHODS

This study uses an actual experiment [24] design to investigate the effectiveness of red dragon fruit extract in preventing dyslipidemia in rats fed a high-cholesterol diet, employing a pre-test-post-test control group design.This research used male Wistar rats (*Rattus Norvegicus*) aged two to three months, weighing 160-200 grams. Due to their anatomy and physiology being similar to humans, they were chosen for biomedical studies. Sample computations involved six animals per group, with four sets randomly assigned to each group [25].The aorta histopathology images in rats were evaluated using a score based on atherosclerotic lesion parameters to determine the difference between the aortas of rats given varying doses of red dragon fruit extract (*Hylocereus Polyrhizus*) and rats given distilled water.The condition of dyslipidemia, including lipid fraction levels (total cholesterol, LDL cholesterol, triglycerides, HDL cholesterol levels, and so on), and aortic histopathology images were measured.

Independent variables affect or have a consequence on dependent variables. In this model, the independent variable predicts the dependent variable's fluctuation rather than manipulating it [26].The researchers housed rats in specially designed plastic cages with delicate wire mesh coverings. They replaced rice husk daily, maintained a temperature range of 25-27°C, relative humidity of 35-50%, and 12-hour light-dark cycle, and fed purified water and normal pellets [27].The extract process involves washing and drying fresh red dragon fruit, mending the flesh, drying in an oven, macerating with 70% ethanol, filtering, and evaporating the crude extract. A suspension is then created from the raw extract[27].After ensuring the data was normally distributed, the researchers ran it via the Shapiro-Wilk test ($p > 0.05$). The significance of the test groups' efficacy was examined using a One-Way ANOVA test ($p < 0.05$). A Post Hoc Test was performed utilizing the LSD approach to determine which treatment group outperformed the other test groups [28].

## III. RESULTS AND DISCUSSION

### Research Result

The study involved 20 white Wistar rats weighing 160-200 grams and divided into four groups. The rats were fed a high-fat diet to test whether red dragon fruit extract could prevent dyslipidemia. The rats were then given varying doses of the extract and housed in controlled cages to ensure the results were unaffected by external influences.

**Table 1.** Characteristics of Test Animals

| *Component* | *Group P0* | *Group P1* | *Group P2* | *Group P3* |
|---|---|---|---|---|
| Rat Type | White *Rattus Norvegicus* wistar strain | | | |
| General Conditions | White coat color, healthy and active | | | |
| Average Initial Body Weight | 261gr | 266gr | 268gr | 268gr |
| Average Final Weight | 250gr | 242gr | 224gr | 203gr |

Mice were fed a high-fat, cholesterol diet, including a dish with higher cholesterol levels, and then treated with red dragon fruit extract for 14 days. Results showed increased total cholesterol and LDL levels and reduced HDL levels, indicating dyslipidemia. Serum cholesterol levels were also measured.

**Table 2.** Total Cholesterol Levels Of Rats Induced With High Cholesterol Diet

| *No* | *Group* | *Repetition* | *Day 0 Cholesterol Level (mg/dl)* | *Day 14 Cholesterol Level (mg/dl)* |
|---|---|---|---|---|
| 1 | | 1 | 52.7 | 60.2 |
| 2 | | 2 | 51.5 | 59.5 |
| 3 | Control | 3 | 50.4 | 58.6 |
| 4 | | 4 | 52. | 58.7 |
| 5 | | 5 | 53.1 | 60.1 |
| 6 | | 6 | 52.3 | 59.2 |
| | | Average | 52.00 | 59.38 |
| 7 | | 1 | 51.5 | 58.7 |
| 8 | Treatment 1 | 2 | 52.9 | 59.8 |
| 9 | | 3 | 51.9 | 59.6 |
| 10 | | 4 | 53.5 | 58.3 |
| 11 | | 5 | 51.2 | 60.5 |
| 12 | | 6 | 51.8 | 58.8 |
| | | Average | 52.13 | 59.28 |
| 13 | | 1 | 52.1 | 58.9 |
| 14 | Treatment 2 | 2 | 53.6 | 59.6 |
| 15 | | 3 | 53.8 | 58.8 |
| 16 | | 4 | 51.2 | 59.3 |
| 17 | | 5 | 51.7 | 59.4 |
| 18 | | 6 | 51.5 | 58.7 |
| | | Average | 52,32 | 59.1 |
| 19 | | 1 | 53.2 | 58.6 |
| 20 | Treatment 3 | 2 | 51.4 | 59.9 |
| 21 | | 3 | 55.7 | 59.4 |
| 22 | | 4 | 51.6 | 57.3 |
| 23 | | 5 | 52.7 | 60.6 |
| 24 | | 6 | 51.2 | 58.3 |
| | | Average | 52.63 | 59.02 |

A blood cholesterol level of 10-54 mg/dl is normal in white Wistar rats (*Rattus Norvegicus*) [29]. Researchers found that rats' total cholesterol levels increased after a high-fat diet, with the control group experiencing an average increase from 52.02mg/dl to 59.42mg/dl. After 14 days, the initial cholesterol levels of treatment groups increased from 52.48 to 59.2 mg/dl. The overall cholesterol levels decreased after 28 days of red dragon fruit extract treatment. However, the control group still had dyslipidemia or high total cholesterol levels, with an average drop from 59.42 mg/dl to 56.62 mg/dl. The treatment group with red dragon fruit extract no longer had dyslipidemia or high total cholesterol levels.

**Table 3.** Total Cholesterol Level of Rats After Treatment

| *No* | *Group* | *Repetition* | *Day 0 Cholesterol Level (mg/dl)* | *Day 14 Cholesterol Level (mg/dl)* |
|---|---|---|---|---|
| 1 | | 1 | 60.2 | 57.5 |
| 2 | Control | 2 | 59.5 | 56.1 |
| 3 | | 3 | 58.6 | 55.6 |

| | | | | |
|---|---|---|---|---|
| 4 | | 4 | 58.7 | 55.8 |
| 5 | | 5 | 60.1 | 58.1 |
| 6 | | 6 | 59.2 | 56.8 |
| | | Average | 59.38 | 56.65 |
| 7 | | 1 | 58.7 | 53.2 |
| 8 | Treatment 1 | 2 | 59.8 | 52.8 |
| 9 | | 3 | 59.6 | 53.2 |
| 10 | | 4 | 58.3 | 52.4 |
| 11 | | 5 | 60.5 | 53.1 |
| 12 | | 6 | 58.8 | 52.1 |
| | | Average | 59.28 | 52.8 |
| 13 | | 1 | 58.9 | 51.2 |
| 14 | Treatment 2 | 2 | 59.6 | 51.7 |
| 15 | | 3 | 58.8 | 50.8 |
| 16 | | 4 | 59.3 | 50.2 |
| 17 | | 5 | 59.4 | 51.3 |
| 18 | | 6 | 58.7 | 50.2 |
| | | Average | 59.11 | 50.9 |
| 19 | | 1 | 58.6 | 49.2 |
| 20 | Treatment 3 | 2 | 59.9 | 48.3 |
| 21 | | 3 | 59.4 | 49.4 |
| 22 | | 4 | 57.3 | 49.5 |
| 23 | | 5 | 60.6 | 50.1 |
| 24 | | 6 | 58.3 | 48.1 |
| | | Average | 59.02 | 49.10 |

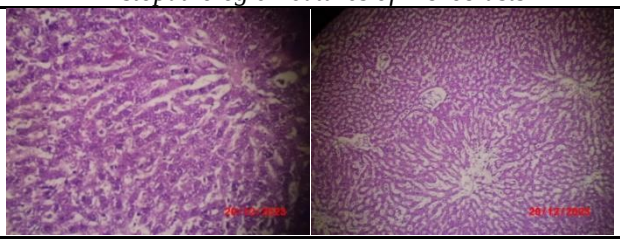
White rats on a high-fat diet had their LDL and HDL cholesterol measured using a phytochemical study of red dragon fruit extract (*Hylocecarus polyrhizus*). Tannin, steroid/triterpenoid, saponin, alkaloid, and flavonoid tests were administered. Flavonoids, alkaloids, saponins, steroids/terpenoids, tannins, and alkaloids were all found in the extract. The production of red or yellow color in the flavonoid test showed a positive result for flavonoids. The presence of yellow or yellowish precipitate in the alkaloid test indicates the presence of alkaloids.The saponin test revealed the presence of saponins by the development of foam. When the steroid/triterpenoid test was run, it produced greenish-greenish results, meaning steroids were present, and reddish-yellow results meant terpenoids were present. The tannin test confirmed tannin's presence, which revealed a green-black liquid. These findings prove that red dragon fruit extract can help with cholesterol management.

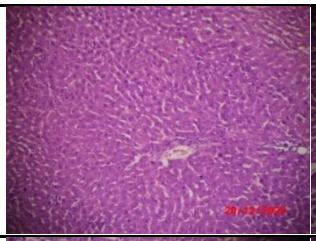
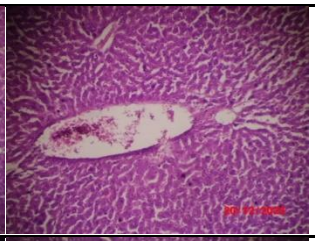
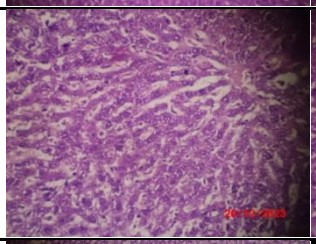
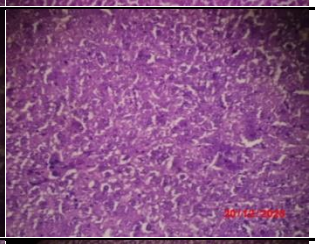
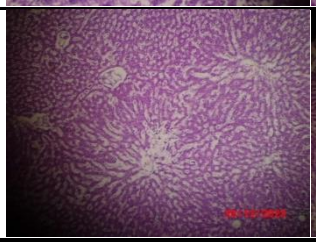
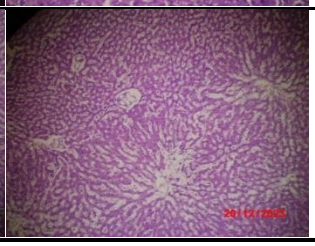
**Table 4.** Phytochemical Test

| Secondary Metabolites | Results | Color |
|---|---|---|
| Flavonoid | + | Red |
| Alkaloid | + | Yellow |
| Saponin | + | There is Froth |
| Steroid | + | Green |
| Tannin | + | Green Blue |

The liver fibroblast cell structure and shape of white rats given a high cholesterol fat diet were studied. The rats were administered several dosages of red dragon fruit extract; the most significant dose resulted in the presence of the densest and most numerous fibroblasts. Fewer and less numerous fibroblast cells were seen in the control group. The red dragon fruit extract treatment groups demonstrated an upregulation of fibroblast cell numbers and densities, with the 120 mg/ml group exhibiting the most pronounced effects. This provides more evidence that red dragon fruit extract could help treat dyslipidemia.

**Table 5.** Histopathology Results

| *No* | *Group* | *Histopathologic Features of Fibroblasts* |
|---|---|---|
| 1 | Control (pelleted feed and distilled equates) |  |

| | | | |
|---|---|---|---|
| 2 | Treatment 1 standard feed + animal treadmill at 20 meters/minute for 30 minutes + red dragon fruit extract 80mg/ml |  |  |
| 3 | Treatment Group-2 (P-2), given standard food + animal treadmill at a speed of 20 meters/minute for 30 minutes + red dragon fruit extract as much as 100mg/ml. |  |  |
| 4 | Treatment Group-3 (P-3), given standard feed + animal treadmill at a speed of 20 meters/minute for 30 minutes + red dragon fruit extract as much as 120mg/ml. |  |  |

**Total Cholesterol Data Analysis**

When figuring out how data is distributed, the normality test is essential. The Shapiro-Wilk test was utilized to determine if this study's data was normally distributed. P values greater than 0.05 suggest a normal distribution, but p values less than 0.05 denote a non-normal distribution. Data collected both before and after the test followed a normal distribution. After that, we utilized the Levene test to see if our study population was homogeneous.

**Table 6.** Total Cholesterol Normality Test

| Group | | *N* | *Sig* |
|---|---|---|---|
| Pre-test | | | |
| | Control | 6 | .427 |
| | P-1 | 6 | .738 |
| | P-2 | 6 | .574 |
| | P-3 | 6 | .979 |
| Post-test | | | |
| | Control | 6 | .550 |
| | P-1 | 6 | .212 |
| | P-2 | 6 | .991 |
| | P-3 | 6 | .819 |

**Table 7.** Total Cholesterol Homogeneity Test Results

| | Levene Static | df1 | df2 | Sig |
|---|---|---|---|---|
| Pre | 1.307 | 3 | 20 | .300 |
| Post | 1.447 | 3 | 20 | .259 |

The Levene test determined group homogeneity at a 5% significance level. The pre-test data had a probability value of 0.300, while the post-test data had a probability value of 0.259. This indicates that the control, treatment 1, and therapy three groups have the same variance, indicating homogeneity.

**Table 8.** One-Way ANOVA Test Results Total Cholesterol

| | | Total | Df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| Pre | Between Groups | .498 | 3 | .166 | .248 | .862 |
| | In Group | 13.422 | 20 | .671 | | |
| | Total | 13.920 | 23 | | | |

| Group | | *Mean difference* | *Sig* |
|---|---|---|---|
| Control | Treatment 1 | 3.85000* | .000 |
| | Treatment 2 | 5.67000* | .000 |
| | Treatment 3 | 7.13000* | .000 |
| P1 | Control | -3.85000* | .000 |
| | Treatment 2 | 1.825000* | .004 |
| | Treatment 3 | 3.28750* | .000 |
| P2 | Control | -5.67000* | .000 |
| | Treatment 1 | -1.82500* | .004 |
| | Treatment 3 | 1.46250* | .012 |
| P3 | Control | -7.13750* | .000 |
| | Treatment 1 | -3.28750* | .000 |
| | Treatment 2 | -1.46250* | .012 |

**Table 9.** Total Cholesterol LSD Post Hoc Test Results

The One-way ANOVA test showed no significant difference in the efficacy of the trial groups, with a pre-test value of 0.862 and a post-test value of 0.000. However, important differences were observed after the tests or following other treatments. The LSD post-hoc test showed significant differences between the control and treatment groups, with values smaller than 0.05.

**LDL Level Data Analysis**

**Table 10.** LDL Normality Test

| Group | *N* | *Sig* |
|---|---|---|
| Pre-test | | |
| Control | 6 | .501 |
| P-1 | 6 | .298 |
| P-2 | 6 | .193 |
| P-3 | 6 | .329 |
| Post-test | | |
| Control | 6 | .879 |
| P-1 | 6 | .415 |
| P-2 | 6 | .425 |
| P-3 | 6 | .753 |

A Shapiro-Wilk test determined if the data was regularly distributed. Both pre-and post-test data were normally distributed, with p-values above 0.05. The Levene test determined if each research population variety was homogenous. This exam is critical for population representation.

**Table 11. LDL Homogeneity Test Results**

| | *Levene Static* | *df1* | *df2* | *Sig* |
|---|---|---|---|---|
| Pre | 2.736 | 3 | 20 | .702 |
| Post | .478 | 3 | 20 | .071 |

The Levene test was used to conduct a homogeneity test between groups, with a 5% significance level. The results showed a probability value of 0.702 for pre-test data and 0.071 for post-test data, indicating homogeneity between the control, treatment groups, and treatment groups, allowing them to proceed to the one-way ANOVA test.

**Table 12.** LDL One-Way ANOVA Test Results

| | | *Total* | *Df* | *Mean square* | *F* | *Sig* |
|---|---|---|---|---|---|---|
| Pre | Between Groups | 1.108 | 3 | .369 | .614 | .614 |
| | In Group | 12.037 | 20 | .602 | | |
| | Total | 13.145 | 23 | | | |
| Post | Between Groups | 125.991 | 3 | 41.997 | 63.358 | .000 |
| | In Group | 13.255 | 20 | .663 | | |
| | Total | 139.246 | 23 | | | |

**Table 13.** Total Cholesterol LSD Post Hoc Test Results

| Group | | *Mean difference* | *Sig* |
|---|---|---|---|
| Control | Treatment 1 | 2.38333* | .000 |
| | Treatment 2 | 4.50000* | .000 |
| | Treatment 3 | 6.10000* | .000 |
| P1 | Control | -2.38333* | .000 |
| | Treatment 2 | 2.11667* | .000 |
| | Treatment 3 | 3.71667* | .000 |
| P2 | Control | -4.50000* | .000 |
| | Treatment 1 | -2.11667* | .000 |
| | Treatment 3 | 1.60000* | .003 |
| P3 | Control | -6.10000* | .000 |
| | Treatment 1 | -3.71667* | .000 |
| | Treatment 2 | -1.60000* | .003 |

The research data passes normality and homogeneity tests, indicating normal distribution and homogeneous variances. The One-way ANOVA test shows a significant difference between the trial groups, marking an essential difference between the control and treatment groups. The LSD post-hoc test results reveal a more minor difference, indicating significant differences between the groups.

**HDL Data Analysis**

**Table 14.** HDL Normality Test

| *Group* | *N* | *Sig* |
|---|---|---|
| Pre-test | | |
| Control | 6 | .459 |
| P-1 | 6 | .874 |
| P-2 | 6 | .628 |
| P-3 | 6 | .377 |
| Post-test | | |
| Control | 6 | .258 |
| P-1 | 6 | .146 |
| P-2 | 6 | .044 |
| P-3 | 6 | .554 |

The study utilized the Kolmogorov-Smirnov test to ascertain if the data follows a normal distribution. With a p-value greater than 0.05, the Shapiro-Wilk Test confirmed that the data followed a normal distribution. Data collected both before and after the test followed a normal distribution. The homogeneity of the research population was determined using the Levene test. This exam is essential to get a good picture of the population.

**Table 15.** HDL Homogeneity Test Results

| | *Levene Static* | *df1* | *df2* | *Sig* |
|---|---|---|---|---|
| Pre | 0.191 | 3 | 20 | .901 |
| Post | 1.829 | 3 | 20 | .174 |

The Levene test was used to conduct a homogeneity test between groups, with a 5% significance level. The results showed a probability value of 0.901 for pre-test data and 0.174 for post-test data, indicating homogeneity between the control, treatment groups, and treatment groups, allowing them to proceed to the one-way ANOVA test.

**Table 16.** HDL One-Way ANOVA Test Results

| | | *Total* | *Df* | *Mean square* | *F* | *Sig* |
|---|---|---|---|---|---|---|
| Pre | Between Groups | .028 | 3 | .009 | .022 | .996 |
| | In Group | 8.612 | 20 | .431 | | |
| | Total | 8.640 | 23 | | | |
| Post | Between Groups | 437.628 | 3 | 145.876 | 562.143 | .000 |
| | In Group | 5.190 | 20 | .259 | | |
| | Total | 442.818 | 23 | | | |

**Table 17. Total Cholesterol LSD Post Hoc Test Results**

| Group | | *Mean difference* | *Sig* |
|---|---|---|---|
| Control | Treatment 1 | -7.05000* | .000 |
| | Treatment 2 | -8.31667* | .000 |
| | Treatment 3 | -11.73333* | .000 |
| P1 | Control | 7.05000* | .000 |
| | Treatment 2 | -1.266667* | .000 |
| | Treatment 3 | -4.69333* | .000 |
| P2 | Control | 8.31667* | .000 |
| | Treatment 1 | 1.266667* | .000 |
| | Treatment 3 | -3.40000* | .000 |
| P3 | Control | 12.32000* | .000 |
| | Treatment 1 | 5.30000* | .000 |
| | Treatment 2 | 3.41567* | .000 |

A one-way ANOVA test was used to check for significant efficacy across trial groups, and the study data also passed the normality and homogeneity tests. Based on pre-test data, there was no statistically significant change in HDL values between the two groups. The Post Hoc LSD test, however, revealed statistically significant changes in the post-test data (p 0.000, less than 0.05).

**Analisa Hasil hs-CRP**

**Table 18.** Result of hs- CRP (High Sensitivity C- Reactive Protein) Screening

| Group | | Hs-CRP Result (mg/L) | Risk Factors |
|---|---|---|---|
| Control | K-1 | 3.35 | High |
| | K-2 | 2.57 | Medium |
| | K-3 | 2.32 | Medium |
| | k-4 | 3.18 | Medium |
| | K-5 | 3.17 | High |
| | K-6 | 3.61 | High |
| P-1 | P1-1 | 2.55 | Medium |
| | P1-2 | 2.34 | Medium |
| | P1-3 | 2.45 | Medium |
| | P1-4 | 1.39 | Medium |
| | P1-5 | 2.32 | Medium |
| | P1-6 | 1.34 | Medium |
| P-2 | P2-1 | 1.44 | Medium |
| | P2-2 | 0.07 | Low |
| | P2-3 | 0.06 | Low |
| | P2-4 | 0.05 | Low |
| | P2-5 | 1.18 | Medium |
| | P2-6 | 1.23 | Medium |
| P-3 | P3-1 | 0.04 | Low |
| | P3-2 | 0.05 | Low |
| | P3-3 | 0.07 | Low |
| | P3-4 | 0.08 | Low |
| | P3-5 | 0.05 | Low |
| | P3-6 | 0.03 | Low |

Evaluation of hs-CRP levels, a biomarker for dyslipidemia disorders. Secondary sources also provided the data used for this analysis (conducted by health professionals at the North Sumatra Provincial Government Clinical Lab). Low hs-CRP levels were determined as 3.0 mg/L on average [30]. The study examined 15 blood samples from current smokers to identify CHD risk variables and looked at hs-CRP (high sensitivity C-Reactive Protein). The results are shown in the table. Table 22 indicates that out of the total number of participants in the study, 3 (12.5 percent) were determined to be at high risk, 12 (50 percent) to be at medium risk, and 9 (9.5 percent) to be at low risk (37.5 percent).

**Research Discussion**

Research investigating the efficiency of providing red dragon fruit extract in avoiding dyslipidemia in white rats (*Rattus Norvegicus*) Wistar strain fed a high-fat diet. Twenty white rats (*Rattus Norvegicus*) Wistar strains were split into four groups for this investigation. Red dragon fruit extract was administered at doses of 3ml to treatment group 1, 4ml to treatment group 2, and 5ml to treatment group 3, with distilled

water as the control group's therapy.Before receiving red dragon fruit extract (*Hylocereus Polyrhizus*) treatments, rats in the control group weighed an average of 260 grams, whereas rats in treatment groups 1 and 2 were 265 and 267 grams, respectively. The rats were weighed again at the end of the trial after the 28th day, and different average findings were obtained for each group. The first treatment group received 230 grams, the second 222 grams, and the final 201 grams; the control group received 250 grams. It is clear from these data that all three groups of test animals lost weight, with treatment group 3 losing the most weight (66 grams).Following a 14-day pre-conditioning period of a high-fat diet consisting of quail egg yolk consumption, the animals were divided into four groups to receive varying treatments: a control group received only distilled water, while the other three groups received preparations of red dragon fruit extract (*Hylocereus Polyrhizus*) at different doses. Total cholesterol, LDL, and HDL values are the indicators used to confirm dyslipidemia in rats.

When these lipid profiles are out of whack, it's called dyslipidemia.When abnormally high amounts of certain lipid particles (such as high-density lipoprotein, low-density lipoprotein, intermediate-density lipoprotein, very low-density lipoprotein, triglycerides, cholesterol, and others) are detected in the blood, this condition is known as dyslipidemia. Hyperlipoproteinemia and hypolipoproteinemia are two forms of dyslipidemia characterized by abnormalities in lipoprotein metabolism. In dyslipidemia, total and LDL cholesterol levels are elevated, while HDL cholesterol levels are lowered [31].One easy technique to detect dyslipidemia is a blood test measuring total, good (HDL), and bad (LDL) cholesterol levels. After that, you'll know if your blood fat levels are too high, too low, or just right. Dyslipidemia occurs when the body's three lipid components are out of whack. To enhance the lipid profile and prevent this disease from worsening, treating it promptly by taking red dragon fruit extract is imperative. Given the potential health benefits of red dragon fruit extract (*Camellia Sinensis*), scientists are eager to test the hypothesis that this fruit's extract, *Hylocereus Polyrhizus*, can lower total and LDL cholesterol levels while increasing HDL levels in white rats (*Rattus Norvegicus*) Wistar strain given a high-fat diet.After fourteen days of observation, this study approach yielded data that required processing and testing, necessitating data analysis. It all starts with processing the acquired data and doing a standard test. The data used for the normality test were obtained with the assistance of SPSS and the Kolmogorov-Smirnov test. All groups' total cholesterol, LDL, and HDL levels, as measured before and after the test, followed a normal distribution, and the p-values were more than 0.05. Therefore, the data can be said to pursue a normal distribution or represent the population as a whole.

The next step is to use the Levene test to check if the normally distributed data represents a normally distributed population with the same variance. Total cholesterol, LDL cholesterol, and HDL cholesterol levels significantly differed between the pre-and post-test data sets ($p>0.05$). We may infer that the control, treatment 1, and therapy three groups are homogenous or originate from the same population in each parameter since the resulting significance probability value is more significant than 0.05. Next, the One-Way ANOVA test was used to check for efficacy and significance in the homogenous and normally distributed data.According to one-way ANOVA testing, all post-test groups' total, LDL, and HDL cholesterol levels had a significance value of 0.000 or above. Further post hoc LSD testing is required since these results show that the control group and treatment groups 1, 2, and 3 differ significantly in the post-test data. We used a post hoc LSD test to look at how different the groups were on average for total cholesterol, LDL, and HDL. All groups exhibit significant differences from other groups, as indicated by the Post Hoc LSD test analysis findings, with a significance value of less than 0.05.The results show that compared to the control group that received merely distilled water, the one treated with red dragon fruit extract (*Camellia Sinensis*) had lower total and LDL cholesterol levels and higher HDL cholesterol levels. Red dragon fruit (*Hylocereus Polyrhizus*) extract contains substances that might induce this, including tannins, steroids, alkaloids, saponins, and flavonoids. The body can fix aberrant lipid profile levels with these bioactive chemicals. These results suggest that a high-fat diet of red dragon fruit extract (*Hylocereus Polyrhizus*) can protect white rats (*Rattus Norvegicus*) Wistar strain from developing dyslipidemia.

## IV. CONCLUSION

Red dragon fruit extract (*Hylocereus Polyrhizus*) effectively prevents dyslipidemia by reducing total and LDL cholesterol levels and increasing HDL levels in white rats (*Rattus Norvegicus*) male Wistar strain fed a high-fat diet.The red dragon fruit extract dose that effectively reduces total cholesterol and LDL levels and increases HDL levels is 120 mg/ml. Total cholesterol levels before and after being given red dragon fruit extract in the group with a dose of 120 mg/ml from the initial level of 59.02 mg/dl to 49.10 mg/dl. Before and after treatment, LDL levels were 30.05mg/dl to 22.03mg/dl. Before and after treatment, HDL levels were 29.12mg/dl to 42.52 mg/dl. Based on the results of the phytochemical test conducted, it is known that red dragon fruit extract (*Hylocereus Polyrhizus*) positively contains secondary metabolites in the form of flavonoids, alkaloids, saponins, tannins, and steroids that can help improve the lipid profile of rats.The One-Way ANOVA test showed a significance value of 0.000 or smaller than 0.05. Based on these data, it can be concluded that there is a significant difference between the control group and the treatment group. The results of the Post Hoc LSD test analysis in this study showed a significance value smaller than 0.05, which means that all groups have significant differences from other groups.More research is required to validate the study's findings and learn more about red dragon fruit extract's potential as an alternative medication to lower LDL and raise HDL levels in human blood.

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