



## The Effect of Single Garlic Extract (*Allium Sativum* Var. Solo Garlic) Administration on Weight Gain in Male *Rattus Wistar* Rats with Dyslipidemia

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### Abstract

*Background:* Dyslipidemia is an abnormal condition (increase or decrease) in cholesterol lipoproteins, including an increase in total cholesterol, triglycerides, and low-density lipoprotein (LDL) levels, as well as a decrease in high-density lipoprotein (HDL) levels. Metabolism plays a role in converting nutrients into compounds necessary for life processes, such as energy sources (ATP). *Research Objective:* To determine the effect of administering single garlic extract (*Allium sativum* var solo garlic) on weight gain in male *Rattus wistar* rats with dyslipidemia. *Research Methods:* This quasi-experimental study used 24 male *Wistar* rats, single garlic extract, butter, quail eggs, used cooking oil, and scales. The study population consisted of 24 male *Wistar* rats, which were divided into four groups of six rats each using Federer's formula. The treatments in this study were: the positive group was given standard feed and simvastatin; the negative group was given standard feed and aquabides; treatment group 1 was given 200 mg/kgBW of single garlic extract; and treatment group 2 was given 400 mg/kgBW of single garlic extract. Body weight assessments were conducted four times, namely on days 7, 14, 21, and 28. The research data analyzed were total cholesterol, LDL count, HDL count, triglyceride count, and body weight. Data were analyzed for normality using the Shapiro-Wilk test, and if normally distributed, continued with a one-way parametric ANOVA test and Tukey HSD post-hoc test. Data were analyzed using IBM SPSS 23 for Windows, with *P* values < 0.05 interpreted as statistically significant. *Research Results:* The mean values and standard deviations for the positive group were 234±13.20 on day 7, 223±12.29 on day 14, 231.83±11.99 on day 21, and 227.5±10.15 on day 28. Negative group on day 7 (237.33±18.52), day 14 (240±7.84), day 21 (238.5±17.28) and day 28 (239.16±9.62). Treatment 1 on day 7 (261.5±27.22), day 14 (296±21.63), day 21 (316.33±21.05) and day 28 (334.16±17.03). Treatment 2 on day 7 (290±10.62), day 14 (327.16±7.41), day 21 (344.33±45.39) and day 28 (385.83±13.43). Administration of 400 mg/kgBW single garlic extract significantly (*P* = 0.02 < 0.05) increased the body weight of rats compared to the positive and negative control groups. *Conclusion:* Based on the results of this study, single garlic extract in test animals showed an increase in body weight in dyslipidemic rats, indicating the need for further research on the mechanism of weight gain due to the administration of single garlic extract.

**Keywords:** Single Garlic Extract, Body Weight, Male *Wistar* Rats, Dyslipidemia.

## 1. INTRODUCTION

Dyslipidemia is an abnormal condition (increase or decrease) in cholesterol lipoproteins, including an increase in total cholesterol, triglycerides, and low-density lipoprotein (LDL) levels, as well as a decrease in high-density lipoprotein (HDL) levels. Dyslipidemia is caused by a shift from a healthy lifestyle to an unhealthy lifestyle, such as a lack of physical activity and a preference for fast food that is high in calories and saturated fat (Pamelia, 2018).

The American Heart Association (AHA) estimates that 98 million Americans currently have cholesterol levels  $\geq 200$  mg/dL, and this number will continue to rise. Dyslipidemia is a major risk factor for coronary artery disease and plays a role before

other major risk factors appear. Epidemiological data show that for every 5-30 mg/dL decrease in LDL, the risk of coronary artery disease is reduced by 30%. The recommended intake of saturated fat to meet the body's needs is 10% per day and cholesterol >300 mg/day. Consuming fatty acids can increase LDL cholesterol levels. If LDL cholesterol increases and HDL decreases, cholesterol will accumulate in peripheral tissues, including blood vessels (Agung, 2021).

Metabolic rate is the total amount of energy produced and used by the body per unit of time (Chen, 2017). Metabolic rate is related to respiration because respiration is a process necessary to produce energy from the oxidation of food molecules that require oxygen (Petra et al., 2002). Metabolism plays a role in converting food substances into compounds necessary for life processes, such as energy sources (ATP). To produce energy sources, food sources such as glucose, amino acids, and fatty acids are broken down through biochemical reactions that occur within the cells of living organisms. Oxygen plays a role in breaking down food sources and forming energy sources that are useful for muscle activity. Several factors influence the metabolic rate or respiratory rate in living organisms, one of which is body weight.

Blood cholesterol levels are influenced by various factors, including diet and physical activity. According to Davison (2012) in (Wulansari, 2017), cholesterol levels are influenced by several factors, namely carbohydrates, protein and fat intake, fiber intake, dietary cholesterol intake, and physical activity.

Fat, or lipids, are substances found in food and are essential for maintaining human health. Fat has several functions in the body, including providing energy and forming fatty tissue (Gifari, 2011). Fat can produce fatty acids and cholesterol, which are necessary for forming cell membranes in organs. However, excessive fat consumption can lead to obesity or excess weight (Kuswara, 2010).

High cholesterol levels can be caused by poor dietary habits. Research by Sari et al. (2014) indicates that there is a correlation between LDL (low-density lipoprotein) cholesterol and fat intake. Uncontrolled consumption patterns, such as consuming foods high in carbohydrates and unhealthy fats, can lead to obesity and excess weight (Setiani, 2012). This causes plaque lesions, occlusion, and embolism due to endothelial dysfunction in patients (PA et al., 2010).

The results of Kawada et al's (2016) study show that dyslipidemia is associated with an increase in waist circumference. A waist circumference above normal is > 90 cm for men and > 80 cm for women (Ministry of Health, 2018). The waist circumference limits for Asian populations at risk of chronic disease are 90 cm for men and 80 cm for women, as recommended by the WHO (Setiati, et al., 2014). An increase in waist circumference is associated with weight gain in patients with dyslipidemia.

Excess weight is a significant risk factor for dyslipidemia (Hasdianah, 2014). Excess calories consumed over time will cause fat accumulation in the body, which over time can lead to weight gain (Kurdanti et al., 2015).

Body Mass Index (BMI) is the easiest way to estimate overweight conditions that correlate with body fat mass. Overweight and obesity are two different things. Overweight is a condition in which a person's weight exceeds normal weight, which can generally come from muscle, bone, fat, and/or water weight. Overweight is the result of excess body fat due to an imbalance between calories consumed and energy expended. Overweight can be influenced by several factors, one of which is environmental factors, namely problems in food selection, eating patterns, portion sizes, and a person's level of physical activity (Husain, et al., 2015).

Obesity and overweight tend to occur together with dyslipidemia. Dyslipidemia is a condition in which there is an imbalance in blood lipid levels. This can occur as a result of an unhealthy lifestyle and visceral fat accumulation, which triggers insulin resistance. Dyslipidemia parameters are based on the 2014 National Cholesterol Education Program (NCEP) criteria, which are obtained when High Density Lipoprotein (HDL) levels are  $\leq 40$  mg/dl (Yuliadewi Luh and Arimbawa Made, 2020).

Patients with dyslipidemia receive pharmacological and non-pharmacological therapy (Fauziana, 2016). Pharmacological therapy may include the administration of anti-lipid drugs, such as statins (PERKENI, 2015). Non-pharmacological therapy includes reducing saturated fat intake, increasing fiber intake, reducing carbohydrate and alcohol intake, increasing daily physical activity, reducing excess weight, and quitting smoking. A high-fiber diet of foods such as nuts, fruits, vegetables, and cereals has a hypocholesterolemic effect (PERKI, 2017).

Garlic (*Allium sativum* L.) is a plant that has been used for many years around the world as a flavoring agent and herbal medicine. Garlic (*Allium sativum* L.) contains organic sulfur compounds and bioactive enzymes. These compounds can improve and maintain overall health. Garlic (*Allium sativum* L.) has a pungent taste and tends to cause stomach discomfort, so its direct consumption as food or medicine is highly restricted. An alternative method to overcome this is fermentation (Afzaal et al., 2021).

Single garlic is garlic that has only one clove and has better antioxidant properties than regular garlic varieties even though it contains the same compounds (Krisnawan et al., 2022). The antibacterial and antifungal properties of single garlic are believed to be due to its chemical component, allicin. Allicin is an active substance that has strong antibiotic properties and acts as an antibacterial agent. Single clove garlic (*Allium sativum*) has greater antibacterial potential than regular garlic. Single clove garlic has antimicrobial potential because it can inhibit the growth of many microbes, including bacteria, fungi, viruses, and protozoa (Wahyuni et al., 2023).

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## 2. RESEARCH METHODOLOGY

### 2.1 Research Stages

This study is a quasi-experimental study with a pre-test and post-test group design. This study examines the effect of single garlic extract (*Allium sativum* var solo garlic) on weight change in male Wistar rats with dyslipidemia. This study was conducted at the Integrated Pharmacology Laboratory of the Faculty of Pharmacy, University of North Sumatra, from January to April 2025. This research has been approved by the Health Research Ethics Committee of Prima Indonesia University with number: 021/KEPK/UNPRI/II/2025. The research materials were 24 male Wistar rats, single garlic extract, butter, quail eggs, used cooking oil, and scales. The research population consisted of 24 male Wistar rats divided into 4 research groups using Federer's formula. Body weight was assessed 4 times, namely on days 7, 14, 21, and 28. The research data analyzed were total cholesterol, LDL count, HDL count, triglyceride count, and body

weight. Data were analyzed for normality using the Shapiro-Wilk test, and if normally distributed, continued with a one-way parametric ANOVA test and Tukey HSD post-hoc test. However, if the data were not normally distributed, data analysis continued with the Kruskal-Wallis test. Data were analyzed using IBM SPSS 23 for Windows, with P values < 0.05 interpreted as statistically significant.

## 2.2 Research Procedure

The study was conducted by dividing the test animals into four research groups, each consisting of six test animals. Group 1 was the positive group, group 2 was the negative group, group 3 was treatment group 1, and group 4 was treatment group 2.

The rats were adapted for 1 week, then given butter, quail eggs, and used cooking oil to induce dyslipidemia for 40 days. Blood samples were taken twice, before the rats were given a high-fat diet and after they were given a high-cholesterol diet.

Division of test animal groups:

- Positive control was given standard feed at a dose of 2-3x/day, simvastatin 2.1 mg/kg rat body weight/day orally
- Negative group was given standard feed at a dose of 2-3x/day, aquabidest/day orally.
- Treatment group 1 was given 200 mg/kg BW of single garlic extract to male *Rattus norvegicus* Wistar rats.
- Treatment group 2 was given 400 mg/kgBW of single garlic extract to male Wistar Norway rats.

## 3. RESULTS AND DISCUSSION

### 3.1 Body Weight Measurement Results

The study was conducted over a period of 1 month to monitor the body weight of rats. The rats were weighed before being given single garlic extract, butter, quail eggs, and used cooking oil, and then weighed again on days 7, 14, 21, and 28. The results of the body weight observations on days 7, 14, 21, and 28 are shown in the following table.

Table 1. Weight Results of Male Wistar Rats

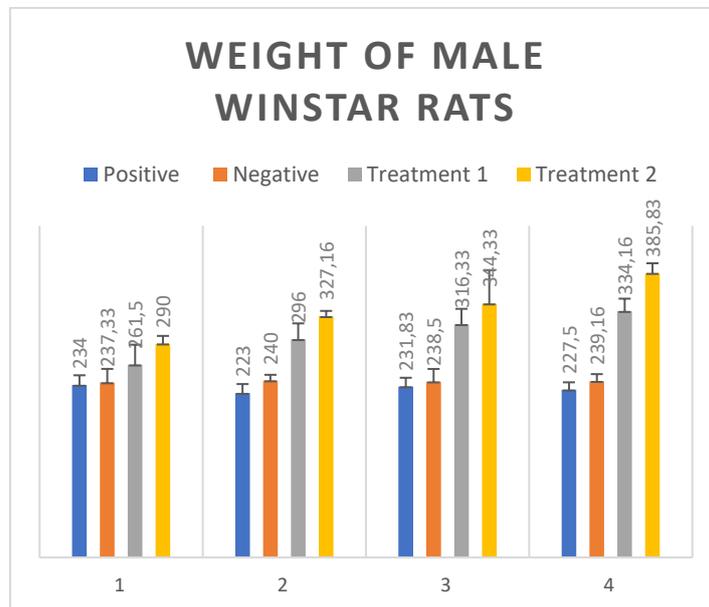
Group		Body Weight (Gram)				
		D-0 (Before Induction)	D-7	D-14	D-21	D-28
Positive	1	204	225	220	235	229
	2	214	245	228	220	211
	3	201	221	210	221	225
	4	202	235	211	232	224
	5	235	254	243	230	237
	6	200	224	226	253	239
Negative	1	193	215	228	220	226
	2	218	267	251	262	250
	3	181	223	235	225	229
	4	223	245	240	257	240
	5	200	231	243	237	245
	6	235	243	243	230	245
Treatment 1	1	205	245	289	330	338
	2	217	289	338	348	355
	3	193	257	289	318	329
	4	205	230	275	289	320
	5	207	248	290	300	312
	6	289	300	295	313	351

Treatment 2	1	175	275	315	389	405
	2	176	281	334	351	397
	3	188	287	329	257	378
	4	199	298	322	367	388
	5	200	301	334	355	378
	6	217	298	329	347	369

Based on Table 1 above, it is explained that the body weight of Wistar rats was measured on day 0 before being given single garlic extract in treatment group 2, then the body weight of Wistar rats was assessed again on day 7, day 14, day 21, and day 28. The results of the table above show an increase in body weight each week in male Wistar rats in all four research groups.

Table 2. Average Results and Standard Deviation of Body Weight

No	Group	Average $\pm$ SD Body Weight			
		D-7	D-14	D-21	D-28
1	Positive	234	223	231.83	227.5
		$\pm$ 13.20	$\pm$ 12.29	$\pm$ 11.99	$\pm$ 10.15
2	Negative	237.33	240	238.5	239.16
		$\pm$ 18.52	$\pm$ 7.84	$\pm$ 17.28	$\pm$ 9.62
3	Treatment 1	261.5	296	316.33	334.16
		$\pm$ 27.22	$\pm$ 21.63	$\pm$ 21.05	$\pm$ 17.03
4	Treatment 2	290	327.16	344.33	385.83
		$\pm$ 10.62	$\pm$ 7.41	$\pm$ 45.39	$\pm$ 13.43



Graph 1. Average and Standard Deviation of Body Weight of Male Wistar Rats on Days 7, 14, 21, and 28

Table 3. Comparison of Mouse Weight Before and After

Research Group	Mean	SD	Sig
Positive	-18.167	15.741	0,788
Negative	-30.833	15.012	0,108
Treatment 1	-114.833	28.993	0,057
Treatment 2	-193.333	28.577	0,024

Based on the table and graph above, the results of the study on male Wistar rats show the mean and standard deviation in the positive group on day 7 ( $234 \pm 13.20$ ), day 14 ( $223 \pm 12.29$ ), day 21 ( $231.83 \pm 11.99$ ), and day 28 ( $227.5 \pm 10.15$ ). The negative group on day 7 ( $237.33 \pm 18.52$ ), day 14 ( $240 \pm 7.84$ ), day 21 ( $238.5 \pm 17.28$ ) and day 28 ( $239.16 \pm 9.62$ ). Treatment 1 on day 7 ( $261.5 \pm 27.22$ ), day 14 ( $296 \pm 21.63$ ), day 21 ( $316.33 \pm 21.05$ ) and day 28 ( $334.16 \pm 17.03$ ). Treatment 2 on day 7 ( $290 \pm 10.62$ ), day 14 ( $327.16 \pm 7.41$ ), day 21 ( $344.33 \pm 45.39$ ) and day 28 ( $385.83 \pm 13.43$ ). Administration of a single garlic extract dose of 400mg/kgBW significantly ( $P = 0.02 < 0.05$ ) increased the body weight of rats compared to the positive and negative control groups.

The results of the study showed that, in general, there was an increase in body weight in test animals given single garlic extract at doses of 200 mg/kg body weight and 400 mg/kg body weight starting on days 7, 14, 21, and 28. Consumption of a high-cholesterol diet caused an increase in blood cholesterol, which is a type of fat. Fat stored in adipose tissue is not used immediately but is stored in the form of triglycerides until it is needed to produce energy. Fat will be hydrolyzed into free fatty acids and glycerol (Nurmawati, 2017).

Research shows that increased protein and fat intake leads to increased blood cholesterol levels (Adachi et al., 2011). However, there are proteins that are hypocholesterolemic or have no effect on cholesterol (Hosomi et al., 2011). Simple carbohydrates have a greater effect on blood cholesterol than complex carbohydrates.

Good nutrition plays an important role in improving the quality of human resources. One nutritional problem is overnutrition, which is characterized by excess weight due to excess fat accumulation in body fat tissue (Hariyani, 2011).

Marwati & Retty, (2011) showed that a high-fat diet does not increase body weight. A high-fat diet does not always increase body weight because stored fat is not always immediately used as an energy source. Large energy reserves reduce appetite. Cholesterol has a very noticeable effect when the body receives a high-fat diet. Cholesterol is very important for the body. Cholesterol is found in all tissues and plasma lipoproteins, both as free cholesterol and combined cholesterol.

Weight gain is a condition in which a person's weight exceeds the normal limit and exceeds their original weight. Weight gain can be defined as a change in weight caused by an increase in food consumption that is converted into fat and stored under the skin (Salim et al., 2021).

According to the WHO, obesity is a condition of excessive fat accumulation caused by a long-term imbalance between energy intake and energy expenditure (Indonesian Ministry of Health, 2020). This imbalance disrupts the lipid profile in the blood, namely, the levels of Low Density Lipoprotein (LDL), Very Low Density Lipoprotein (VLDL), and triglycerides increase, while the level of High Density Lipoprotein (HDL) decreases. A high-fat diet is also a risk factor for obesity. One parameter often used to assess the risk factors for obesity is the plasma atherogenic index (IAP) (Gibran & Nurulhuda, 2023).

An increase in Body Mass Index (BMI) is associated with an abnormal lipid profile, namely a decrease in High Density Lipoprotein (HDL) levels. High Density Lipoprotein (HDL) is often referred to as good cholesterol, which has more protein molecules than fat. High-Density Lipoprotein (HDL) works by transporting bad cholesterol from the blood vessel endothelium, then transporting it to the liver and then excreting it through the digestive tract so that cholesterol does not accumulate in the blood vessels and prevents atherosclerosis. High cholesterol levels originating from High-Density Lipoprotein (HDL) have a positive effect on blood vessels and, indirectly, on the heart (Rafsanjani Muh et al., 2019).

Fat accumulation affects cholesterol increase. Increased cholesterol plays a role in the formation of free radicals accelerated by oxidative stress. Oxidative stress can cause damage to biological macromolecules, including LDL cholesterol oxidation, triglycerides, endothelial dysfunction, and increased inflammatory response. A person who is obese will trigger an increase in oxidative stress, which is an imbalance between antioxidant activity and free radical production in the body (Midah et al., 2021).

Single clove garlic extract is known to contain antioxidants, and the antioxidant compounds found in single clove garlic extract that can increase lipoprotein lipase enzyme activity are flavonoids. Based on the results of research by Ettehad et al. (2022) on changes in anthropometric indices during research on obese women, body mass index decreased significantly in both groups from baseline values. BMI decreased by 1.7% in the Allium group and 2.7% in the placebo group ( $P < 0.01$ ). The decrease in BMI was higher in the placebo group than in the Allium group. Body weight, waist circumference, hip circumference, and WHtR decreased significantly in both the Allium and placebo groups ( $P < 0.01$ ). There were no significant differences between the two groups when adjusted for baseline values ( $P > 0.05$ ). This contrasts with the results of a study by researchers who found that administration of 400 mg/kg body weight of garlic extract had an effect of increasing body weight in test animals, thus constituting a novelty in research and serving as a theoretical comparison.

#### 4. CONCLUSION

The results of the study concluded that there was an increase in the body weight of male Wistar rats in treatment group 2 that were given 400 mg/kgBW of garlic extract compared to the group that was only given standard feed, with a significant value ( $P = 0.02 < 0.05$ ), thus indicating the need for further research on the mechanism of action of garlic extract alone on weight gain.

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