COMPARISON OF THE EFFECTIVENESS OF FERMENTED TIWAI ONIONS AND LANANG ONIONS ON CHOLESTEROL LEVELS IN SPRAGUE DAWLEY HYPERCHOLESTEROLEMIA RATS

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ABSTRACT

This study was a pure experimental study using a control group. The experimental animals used were two-month-old Sprague Dawley rats. The four groups of rats were given a high-cholesterol diet with the addition of egg yolk to the feed for two weeks. After the rats experienced hypercholesterolemia, the rats were divided into four groups. The first group was the control group given distilled water. The second group was given simvastatin at a dose of 15 mg/kgBW. The third group was given fermented shallots at a dose of 200 mg/kgBW, and the fourth group was given fermented shallots at a dose of 200 mg/kgBW. Each group consisted of five rats. The results of the ANOVA test showed a significant difference in cholesterol levels between groups with a p value = 0.00. The Tukey HSD further test showed a difference in mean HDL between the control group and the group given simvastatin. However, no significant difference was found in cholesterol levels between the groups given fermented shallots and fermented shallots. The groups given fermented shallots and lanang shallots had lower mean cholesterol compared to the control and simvastatin groups. The conclusion of this study is that the administration of fermented tiwai and lanang onions both showed effectiveness in lowering blood cholesterol levels in rats with hypercholesterolemia, as effective as simvastatin. This finding shows the potential of fermented onions as an alternative herbal therapy in managing high cholesterol.

Keywords **:** Hypercholesterolemia, Fermentation, Lanang Onion, Tiwai Onion

ABSTRAK

Penelitian ini merupakan penelitian eksperimental murni dengan menggunakan kelompok kontrol. Hewan coba yang digunakan adalah tikus Sprague Dawley berumur dua bulan. Keempat kelompok tikus diberikan diet tinggi kolesterol dengan penambahan kuning telur ke dalam pakan selama dua minggu. Setelah tikus mengalami hiperkolesterolemia, tikus dibagi menjadi empat kelompok. Kelompok pertama merupakan kelompok kontrol yang diberi air suling. Kelompok kedua diberi obat simvastatin dosis 15 mg/kgBB. Kelompok ketiga diberi bawang tiwai fermentasi dosis 200 mg/kgBB, dan kelompok keempat diberi bawang lanang fermentasi dosis 200 mg/kgBB. Masing-masing kelompok terdiri dari lima ekor tikus. Hasil uji ANOVA menunjukkan terdapat perbedaan signifikan kadar kolesterol antar kelompok dengan nilai p = 0,00. Uji lanjut Tukey HSD menunjukkan adanya perbedaan rerata HDL antara kelompok kontrol dan kelompok yang diberi simvastatin. Namun, tidak ditemukan perbedaan signifikan kadar kolesterol antara kelompok yang diberi bawang tiwai fermentasi dan bawang lanang fermentasi. Kelompok yang diberi bawang tiwai dan bawang lanang fermentasi memiliki rerata kolesterol lebih rendah dibandingkan dengan kelompok kontrol dan simvastatin. Kesimpulan penelitian ini pemberian bawang tiwai dan bawang lanang yang telah difermentasi sama-sama menunjukkan efektivitas dalam menurunkan kadar kolesterol darah pada tikus yang mengalami hiperkolesterolemia, sama efektifnya dengan simvastatin. Temuan ini menunjukkan potensi bawang fermentasi sebagai alternatif terapi herbal dalam pengelolaan kolesterol tinggi.

Kata Kunci **:** Hiperkolesterolemia, Fermentasi, Bawang Lanang, Bawang Tiwai

INTRODUCTION

Hypercholesterolemia is a condition in which the body experiences an increase in cholesterol levels above the normal threshold (Ellyzabeth Sukmawati et al., 2022; Mudrikatin, 2020; Rahayu et al., 2021). Hypercholesterolemia is characterized by an increase in total cholesterol levels, Low Density Lipoprotein (LDL) cholesterol, and a decrease in High Density Lipoprotein (HDL) as well as an increase in triglyceride levels in the sufferer's body (Kiran, 2010). Hypercholesterolemia is a condition where the total cholesterol level in the blood increases to ≥ 240 mg/dl or exceeds the normal limit (120-200 mg/dl) which is caused by impaired fat metabolism fat (Sukmawati, 2018).

The percentage of high cholesterol recorded at Integrated Development Posts (Posbindu) for Non-Disease Diseases and Community Health Centers that have used the non-communicable disease surveillance information system in provincial data, the percentage of visitors with high cholesterol at Posbindu and first level health facilities in Indonesia is highest in West Papua Province namely 70%, while in East Kalimantan province people with high cholesterol are 46.8%. Increased cholesterol levels in the body can occur as a result of lifestyle changes and unhealthy eating patterns which tend to contain high levels of carbohydrates and high fats. The number will increase with age, the highest age group is 65 - 74 years (Kemenkes RI, 2017).

Efforts that can be made to prevent increased levels of cholesterol in the blood include using an additive in garlic (allicin). Garlic contains the active compound allicin, research (Wignjosoesastro, C., Arieselia, Z., 2014) states that the allicin content in garlic contains an unsaturated diallyl sulfide structural compound which can reduce NADP and NADPH levels so that it can inhibit the synthesis of cholesterol in the blood.

Apart from that, garlic can be processed into black garlic by heating at a temperature of 65-80^{o}C with a relative humidity of 70-80% for 30 days, the compound contained in black garlic, namely allicin, will increase five times higher than with fresh garlic 5-6. Based on research using 24 mice with concentrations of 80%, 60%, 40% and 20%, it can reduce cholesterol levels in mice. Based on one way ANOVA data analysis, the results obtained were sig 0.000 < a (0.05), which means that there was an effect of giving black onion extract on reducing cholesterol levels (Romunza, A, 2018).

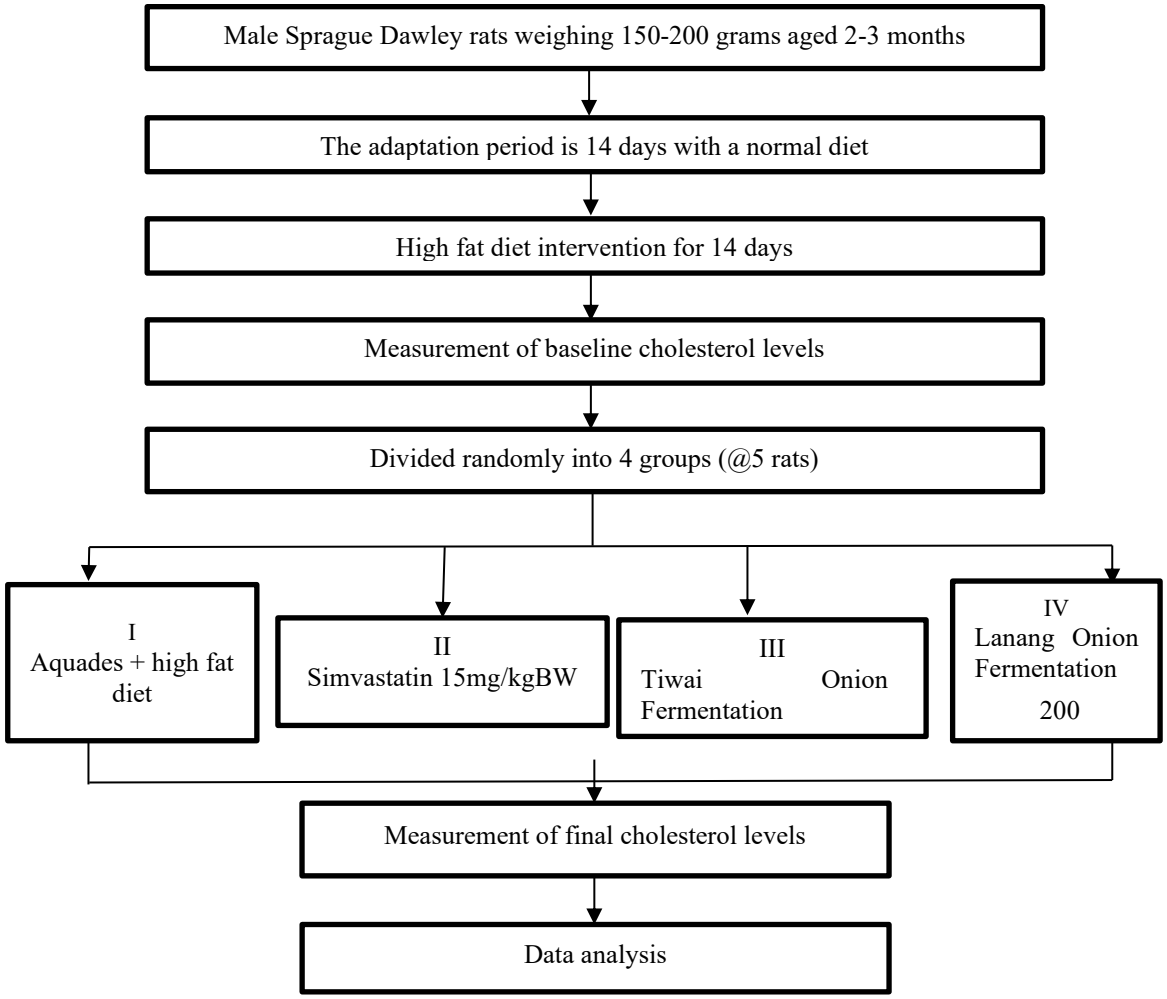
Tiwai onions are a plant that is widely known by the public as a traditional medicinal plant. According to research, this plant can be used as a medicine for dysuria, colitis, dysentery, jaundice, wounds, boils, diabetes mellitus, hypertension, lowering cholesterol, and breast cancer (Galingging, 2009).

Research conducted states that tiwai onion tuber extract has the ability to effectively reduce blood cholesterol and triglycerides. Residents of the Tiwai tribe in Central Kalimantan use these onions to increase breast milk production, treat diabetes, breast cancer, stroke, hypertension and sexual disorders (Kusuma et al., 2016). The aim of this research is to determine the effectiveness of giving tiwai onions and black onions to reduce cholesterol levels in pre-syndrome Sprague Dawley rats. metabolic. Not many studies have explored fermented tiwai onions to reduce cholesterol levels. The benefits that can be achieved in this research are as an alternative food to reduce the risk of metabolic syndrome and hypercholesterolemia so that it can prevent degenerative diseases.

METHOD

This research was carried out for 3 months, namely from July to September 2023 starting from the preparation of materials to the analysis of cholesterol levels in Sprague Dawley rats. This research was carried out at the Chemistry Laboratory of the Samarinda State Agricultural Polytechnic and the Food Ingredient Science Laboratory of the Health Polytechnic, Ministry of Health, East Kalimantan. This research is pure experimental research using controls. The experimental animals used were two-month-old Sprague Dawley rats. The four groups were given a high cholesterol diet with the addition of egg yolk to their feed for 2 weeks. After the mice experienced hypercholesterolemia, the mice were divided into 4 groups. These groups consisted of the first group, namely the control group, namely rats that were given distilled water, the second group, namely rats that were given the drug simvastatin 15 mg/kgBW, the third group that was given fermented tiwai onions at a dose of 200 mg/kgBW, and the fourth group that was given fermented spring onions at a dose of 200 mg/kgBW and each group consisted of 5 mice. Statistical analysis was performed using the Kruskal-Wallis test for nonparametric data, followed by the Mann-Whitney comparison test and one-way ANOVA analysis. The level of significance was set at $p < 0.05$. Statistical analysis was carried out by computer using the SPSS for Windows version 20.0 program (Sugiyono 2020, 2020)

Figure 1. Research flow chart



RESULT

Average Cholesterol Levels

The average cholesterol levels in this study can be seen in the distribution table below:
Based on Table 1 above, it shows that the highest pre-test cholesterol levels were in group II (195.08 ± 4.43) and the lowest were in group III (192.70 ± 2.99), while the highest post-test cholesterol levels were in group I (194.22 ± 3.89) and the lowest in group III (103.85 ± 1.77)

Table 1. Average cholesterol levels after intervention for 14 days

Treatment Group (mg/dl)	I Mean±SD	II Mean±SD	III Mean±SD	IV Mean±SD	p
Pre	192,70±3,92	195,08±4,43	192,70±2,99	192,98±3,21	0,749
Post	194,22±3,89	114,22±3,20	103,85±1,77	107,11±3,79	0,208

Homogeneity Of Variance Test

The first statistical test used is the homogeneity of variance test to test homogeneous data variance using the Levene Test. This shows the significance value or p > a (0.05), so it can be concluded that H0 is accepted. This means that the variance of the cholesterol level data is homogeneous, so it can be continued with the One Way Analysis of Variance (One Way ANOVA) test to determine the differences in the four treatment groups

One Way Anova Test

The results of the One Way ANOVA test on all groups show a significance value or p (0.000) < α (0.05), so it can be concluded that Ho is rejected, which means there is at least one different treatment group.

Tukey's Post Hoc Multiple Comparison Of Cholesterol Levels

Tukey's Post Hoc Multiple Comparison Test was used to see differences in cholesterol levels in all groups, the results of which can be seen below: To determine the difference in cholesterol levels in each group, it is indicated by a significance value or p < α (0.05). Based on the data above, it can be seen that there are differences in cholesterol levels between group I and other groups in this study. Tukey's Post Hoc Test also explains that there are several groups that have a significance value or p > α (0.05). This shows that there is no difference in cholesterol levels between the two groups being compared. Based on the research results, it was found that there was no difference in cholesterol levels between group III and group IV with p=0.422, which means that the use of fermented tiwai onions at a dose of 200 mg/kgBW with 200 mg/kgBW of lanang onions had the same effectiveness in reducing cholesterol levels.

This is in line with research which shows that the livers of mice given fermented shallots (200 mg/kgBW) showed improvements in the macroscopic appearance of the mice's livers and the histological structure of the liver which showed decreased inflammation (Tran et al., 2020). Increasing cholesterol levels is positively related to increasing SGOT and SGPT levels. This occurs due to liver damage which will cause disruption of fat metabolism and an increase in serum SGOT and SGPT in the blood (Kurniati, 2012). In the book The Garlic Book by Stephen Fulder in 1997 in Wignjosoesastro, C., Arieselia, Z. (2014) it was revealed that the allicin content in garlic can inhibit cholesterol synthesis (Wignjosoesastro, C., Arieselia, Z., 2014).

Table 2. Tukey post hoc multiple comparison of cholesterol levels

	p Value in each group			
Groups	I	II	III	IV
I	-	0,000	0,000	0,000
II	0,000	-	0,001	0,016
III	0,000	0,001	-	0,422
IV	0,000	0,016	0,422	-

The same thing was also conveyed by a study that giving tiwai onion extract to experimental animals induced by quail egg yolk for 14 days at a dose of 200 mg/kgBW was able to reduce total cholesterol levels by an average of 72 ± 8.2 mg/dL compared to a dose of 100 mg/kgBW with a mean of 83 ± 7.8 mg/dL and a dose of 50 mg/kg BW with a mean of 92.2 ± 6.6 mg/dL although the results obtained were not statistically significantly different (Kusuma et al., 2016). The eleutherine compound is a compound that has the potential to act as an antioxidant found at the base of the tuber. In a study, it was found that 70% ethanol extract of tiwai onions contained flavonoids, saponins, phenolics and tannins (Sukmawati, 2018). Compounds that are thought to have fat inhibitory activity are flavonoid compound (Pratiwi et al., 2013). Flavonoid compounds are secondary metabolic compounds that are abundant in the epidermis of tiwai onion bulbs and have the potential to act as antioxidants for this plant. Flavonoids can reduce cholesterol levels by inhibiting cholesterol absorption, increasing bile secretion, and can inhibit the activity of the HMG-CoA reductase enzyme which plays a role in inhibiting cholesterol synthesis and the acetyl CoA enzyme which plays a role in reducing cholesterol esterification in the intestines and liver (Pratiwi et al., 2013).

Apart from the allicin content in white onions and flavonoids in tiwai onions, the effectiveness of these two onions can occur because the ripening process in making black onions produces antioxidant, phenol and flavonoid compound content which increases four to five times compared to fresh garlic and onions fresh lanang (Bae et al., 2014; S et al., 2014). The results of this study indicate that both fermented lanang garlic and fermented tiwai onion are effective in reducing cholesterol levels in hypercholesterolemic rats, each with its own distinct advantages. Fermentation plays a crucial role in enhancing the bioavailability of active compounds by converting them into more readily absorbable forms. For instance, allicin, a major bioactive component in garlic, is hydrolyzed during fermentation into ajoene and other sulfur-containing compounds that exhibit stronger biological activity (Ellyzabeth, 2018).

Lanang garlic demonstrated superior efficacy in reducing total cholesterol and LDL (low-density lipoprotein) levels (Budianto et al., 2024; Cahyaningrum & Cita, 2022; Cita & Cahyaningrum, 2023). This can be attributed to its high allicin content, which is known to inhibit the enzyme HMG-CoA reductase—a key enzyme in the cholesterol biosynthesis pathway. Furthermore, the sulfur compounds present in lanang garlic contribute to the acceleration of lipid metabolism, enhancing its lipid-lowering effects.On the other hand, tiwai onion, despite having a lower allicin concentration, showed greater potential in elevating HDL (high-density lipoprotein) levels. This may be due to its rich content of flavonoids and antioxidants, which play a vital role in protecting lipoproteins from oxidative damage, thereby supporting HDL enhancement and contributing to the prevention of atherosclerosis. Additionally, fermentation with lactic acid bacteria offers probiotic benefits, potentially improving gut microbiota health. A growing body of research has linked a balanced gut microbiome to better cholesterol metabolism. Therefore, the use of fermented products adds

further value compared to their raw counterparts, both in terms of bioactive potency and health-promoting effects.

CONCLUSION

Fermented onion and onion administration were equally effective in increasing cholesterol levels in the treatment group. This is shown by the difference in average cholesterol levels with the control group and the treatment given simvastatin

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