

Effect of Giving Black Fermented Glutinous Black Rice against Total Cholesterol Levels



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Abstract— Hypercholesterolemia becomes one of the factors of vascular disease. The abnormal total cholesterol levels result in inhibition of blood vessels because it can cause atherosclerosis. Anthocyanin that contains in Fermented Glutinous Black Rice as one functional food is recommended to lower total cholesterol levels. The purpose of this study is to determine the effect of fermented Fermented Glutinous Black Rice to total cholesterol levels.

This study method used two group pre test and posttest experimental design. This research was conducted in January 2017 - February 2017. Samples are residents of Budiharja Village, Cililin sub-district, West Bandung regency, men and women aged over 36 years old with menopause women excluded. The sample of the study amounted to 36 people. The sample was divided into two study groups of each of 18 samples. Before and after the intervention, total cholesterol levels were examined in both groups. Also performed SQFFQ and recall 1x24 hours every three days during the study.

The results of the analysis with Dependent T-test of the intervention group showed a decrease in initial total cholesterol levels of 224.61 mg/dL became 194,11 mg/dL with $p < 0,001$. The analysis result with Mann Whitney Test showed that there is decrease total cholesterol level between intervention group and control group ($p < 0,001$). So, one of the way to decreasing the total cholesterol levels could be started by consuming Fermented Glutinous Black Rice.

Keywords: Cholesterol total, Fermented Glutinous Black Rice, anthocyanin

Introduction

Hypercholesterolemia is a major cause of diseases related to atherosclerosis, cerebrovascular ischemia and other vascular diseases. Hypercholesterolemia is also a disorder that often occurs in hyperlipidemia [1].

One of the blood vessel diseases caused by hypercholesterolemia is cardiovascular disease. Cardiovascular disease is the result of atherosclerosis and is the leading cause of death in both developed and developing countries and has been reported as much as 13.2% of total deaths in the world due to heart attacks. It is now known that there is an association between an increase in serum cholesterol and an increase in the severity of atherosclerosis [1,2].

In general, 90% of cases of heart disease are preceded by the onset of atherosclerosis, which is an accumulation of cholesterol in the lining of the arteries as a result of high blood cholesterol levels or hypercholesterolemia. And there is about half of the body's cholesterol comes from the synthesis process (about 700 mg / day) and the rest is obtained from food [3].

According to a WHO report in 2011, it is estimated that around 35% of Indonesia's population has cholesterol levels higher than normal limits [4]. Other studies in Indonesia include a prospective cohort study for the pattern of metabolic syndrome and Non-Communicable Diseases (PTM) in

2012 in Central Bogor District, Bogor City, showing the proportion of total cholesterol levels was 49% [5]. And the data from Riskeudas in 2013, for people > 15 years, the total cholesterol was abnormal at 35.9% [6]. This means that the Indonesian population is at high risk of developing arterial disease.

Food intake is closely related to hypercholesterolemia. Excessive fat consumption is associated with high total blood cholesterol levels [7]. West Java occupies the third position of the five highest provinces with the behavior of consumption of fatty foods, cholesterol, and fried foods \geq 1 time per day. The five provinces are Central Java (60.3%), DI Yogyakarta (50.7%), West Java (50.1%), East Java (49.5%), and Banten (48.8%) [7].

The results of Helmidzar's research in 2010 found a significant relationship between consumption of antioxidant sources and lipid profile after controlling for confounding variables, namely age. One of the non-nutritional antioxidant compounds found in food ingredients is anthocyanins which have natural pigments found in red, blue, purple to black cereals with cyanidin-3-glucoside and peonidin-3-glucoside components [8,25].

One source of anthocyanins other than fruits and vegetables is rice (*oryza sativa*) which is rich in anthocyanins such as black glutinous rice, black rice and brown rice [9].

Black glutinous rice in Indonesia has not yet been developed optimally into food products even though its properties are already known. One of the options for processing rice in food products is processing rice by fermentation, one of which is Fermented Glutinous Black Rice [10]. The Fermented Glutinous Black Rice is a fermented product made from black glutinous rice which is then fermented for two to three days and finally produces Fermented Glutinous Black Rice, organic acids, and alcohol.

Fermented Glutinous Black Rice has the potential as an anthocyanin carrier that is known to have health benefits because it is an antioxidant that can protect blood cholesterol from oxidation attacks by free radicals that can trigger atherosclerosis as a result of hypercholesterolemia. [11]

The need for anthocyanins according to Elisa Pojer et al. Each person ranges from a few milligrams to 200 mg per day [12].

The anthocyanin component of Fermented Glutinous Black Rice is a type of cyanidine 3 - glycoside with a substituted hydroxylation pattern at position 3. The anthocyanin content in Fermented Glutinous Black Rice is 257 ppm or the equivalent of 257 mg anthocyanin in 1 kg of Fermented Glutinous Black Rice [13]. So by giving 200 grams of Fermented Glutinous Black Rice, it has fulfilled half the daily anthocyanin needs or 51.7 mg of anthocyanin, while other anthocyanin needs are obtained from other foods.

Method

This study used an experimental research design (two group pre-post experimental test design) to determine the effect of giving black Fermented Glutinous Black Rice to total cholesterol levels before and after treatment. Two research groups, namely the intervention group were given 200 grams of Fermented Glutinous Black Rice and low-fat diet counseling for 30 days, while the control group was only given diet counseling for 30 days. This research was conducted in January 2017 - February 2017 in Budiharja Village, Cililin District, West Bandung Regency. The minimum sample size needed is 36 people with 18 people for each intervention and control group.

Samples were taken using purposive sampling method with a population of all adult males and females over the age of 36 years in Budiharja Village and taken again based on the following inclusion criteria: male and / or female, aged over 36 years, have total cholesterol levels > 140 mg

/ dL, and willing to be a communicative sample. While the exclusion criteria for the sample include: female menopause, pregnant or breastfeeding, and suffering from gout for the treatment group.

The data collected from the sample included the results of the initial and final total cholesterol levels, uric acid test results, sample identity, energy, fat, and fiber intake. Data asupan energi, lemak, dan serat diperoleh dengan melakukan SQFFQ at the beginning of the examination, then the intake was controlled using the 1x24 hour recall method every 3 days. At the end of the study, laboratory examinations were carried out in both groups to see differences in total cholesterol levels after 30 days.

Data analysis used Dependent T-test to see a decrease in total cholesterol levels before and after in each group. While the data analysis using the Mann Whitney Test is used to analyze the effect of giving black Fermented Glutinous Black Rice to a decrease in total cholesterol levels.

Result

Based on the table. 1 It is known that most of the research samples were female with a median value of 42 years 5 months in the intervention group and 43 years 5 months in the control group.

Table. 1 Characteristics of the sample based on age and gender

Variable	Group	Mean	SD	Median	Min	Maks	p _{value} *
Age	Intervention (n=18)	43,333	7,170	42,500	36,000	70,000	0,247
	Control (n=18)	44,667	7,340	43,500	36,000	65,000	
		Woman		Man		p_{value}*	
Gender	Intervention (n=18)	14	28,57%	4	50,00%	0,0082	
	Control (n=18)	9	71,43%	9	50,00%		

*Independent T-test **Chi-Square

Table 2 describes the characteristics of the sample based on the percentage of intake of each group before and after the intervention. Based on the table, the percentage of energy, fat, and fiber intake was higher before the intervention in both the intervention and control groups.

Table.2 Characteristics of the sample based on percentage of intake

Variable	Group	Mean	Median	SD	Min-Maks	p _{value} *
Pre Energy Percentage (%)	Intervention (n=18)	115,507	112,120	11,571	95,00-134,64	0,605*
	Control (n=18)	111,967	106,925	20,068	93,23-165,93	
Post Energy Percentage (%)	Intervention (n=18)	98,569	99,440	7,212	83,29-108,03	0,075**
	Control (n=18)	94,697	91,190	8,471	81,79-107,77	
Pre Fat Percentage (%)	Intervention (n=18)	105,694	107,005	6,568	90,14-116,79	0,200**
	Control (n=18)	103,351	106,050	9,67	87,28-117,48	

Post Fat Percentage (%)	Intervention (n=18)	94,493	93,730	6,783	85,87-105,37	0,150**
	Control (n=18)	92,027	90,590	7,267	80,82-105,18	
Pre Fiber Percentage (%)	Intervention (n=18)	35,022	33,400	10,731	18,40-57,20	0,446**
	Control (n=18)	35,533	34,000	11,455	19,20-56,00	
Post Fiber Percentage (%)	Intervention (n=18)	24,244	23,200	23,200	11,60-38,00	0,174**
	Control (n=18)	26,722	26,400	8,539	14,80-41,20	

*Mann Whitney Test ** Independent T-test

Based on the tests that have been carried out on the two tables, it does not show that there is a statistically significant difference between the intervention group and the control group. This condition shows a homogeneous condition in the two sample groups.

Furthermore, food intake is known by recall which is carried out every 3 days. After 30 days of the study, it is known that the results of the difference in total cholesterol levels in the intervention group and the control group before and after the intervention.

Table 3. Description of total cholesterol levels before and after in the intervention group

Variable		Mean	SD	Median	Min	Maks	p _{value} *
Total Cholesterol Levels	Pre	224,61	41,74	226,50	149,00	288,00	<0.001
	Post	194,11	41,48	192,00	123,00	269,00	

*Dependent T-test

Table 3 shows that there was a decrease in total cholesterol levels before and after in the intervention group statistically with a p value <0.001 ($p \leq 0.05$) with a decrease in total cholesterol levels of 30.5 mg / dL. Whereas in table 4, it shows that there was no decrease in total cholesterol levels in the control group statistically with a value of $p = 0.256$ ($p > 0.05$).

Table 4. Description of total cholesterol levels before and after in the control group

Variable		Mean	SD	Median	Min	Maks	p _{value} *
Total Cholesterol Levels	Pre	212,44	45,05	215,00	140,00	294,00	0,256
	Post	210,33	43,63	204,00	126,00	290,00	

*Dependent T-test

Based on table 5, it shows that there is an effect of giving Fermented Glutinous Black Rice to total cholesterol levels with a statistical value of $p < 0.001$ ($p \leq 0.05$).

From these data, it shows that the reduction in total cholesterol levels in the intervention group is greater than the control group.

Table 5. Description of changes in total cholesterol levels between the intervention group and the control group

Variable	Group	Mean	SD	Median	Min	Maks	p _{value} *
Kadar	Intervention	30,50	19,62	23,00	10,00	79,00	<0,001

Kolesterol	(n=18)					
Total	Control	2,11	13,42	2,50	19,00	-31,00
	(n=18)					

**Mann Whitney Test*

Discussion

To test the administration of black Fermented Glutinous Black Rice to total cholesterol levels, a study was conducted on the community of Budiharja Village who were given black Fermented Glutinous Black Rice for 30 days.

A total of 36 samples were divided into 2 groups, each with 18 samples, namely the intervention group who was given 200 g of Fermented Glutinous Black Rice and education on low-fat diet and 18 control groups who were only given education on low-fat diet.

At the beginning of the study, the samples were examined for energy, fat and fiber intake. Interviews were conducted to determine the habits of energy, fat and fiber intake using the Semiquantitative Food Frequency Questioner (SFFQ) form. Then SFFQ was analyzed and compared with the needs of each sample to determine the percentage of energy intake, fat, and fiber samples at the beginning of the study before treatment. Because the normality of the percentage of energy intake data is not normal, to see the percentage of energy intake, the average is not used but the median. This is because there are extreme data values.

To control food intake and consumption of Fermented Glutinous Black Rice during the study, interviews were conducted regarding food intake using the recall method every 3 days. At the end of the study all recall data were analyzed and averaged to determine the intake of energy, fat, fiber. Then the final intake data is compared with the energy and nutrient requirements of each sample.

Age

Based on the age characteristics of the study sample, in the intervention group the median age of the sample was 42 years 5 months, while in the control sample group it was 43 years 5 months. From both groups, it can be seen that the intervention group has a slightly younger age range than the control group. After the statistical test was obtained $p = 0.247$ ($p > 0.05$) there was no age difference between the intervention and control groups, so that the two sample groups were comparable.

With increasing age, the risk of increasing total cholesterol levels in the body becomes greater due to structural changes in blood vessels due to the atherosclerosis process. Basically, the process of atherosclerosis begins in childhood, but clinical manifestations of this process are only seen in late adulthood (36 - 45 years). This process takes place slowly, causing an increase in total cholesterol levels in the body [14].

Gender

Estrogen is a sex hormone in women that can lower blood cholesterol and androgen is a sex hormone in men that can increase blood cholesterol levels. Decreased production of the hormone estrogen will lead to tissue atrophy, increased abdominal fat, increased total cholesterol, and subsequently the risk of developing heart disease [15].

Based on the results of the statistical test, the value of $p = 0.082$ ($p > 0.05$) was obtained, this indicates that there was no gender difference in the intervention group and the control group. So that the two samples are comparable.

Percentage of Energy Intake

Excess energy will be stored by the body in the form of fat. Accumulation of body fat, especially in the middle (abdominal) will increase the risk of insulin resistance, hypertension, hypercholesterolemia [16].

Based on the statistical test, it was obtained that the percentage of initial energy intake with a value of $p = 0.605$ and $p = 0.075$ in the percentage of final energy intake indicated that there was no difference in the percentage of energy intake in the intervention group and the control group ($p > 0.05$). So that the percentage of energy intake data used is comparable.

Percentage of Fat Intake

A high-fat diet can result in excess triglycerides in adipocyte tissue [27]. This causes the adipocyte tissue to stimulate the release of TNF- α cytokines. Increased levels of TNF- α lead to insulin resistance. Insulin resistance in adipocytes can reduce the activity of the lipoprotein lipase enzyme so that it will increase levels of total cholesterol and LDL in the blood [17,26].

Based on the statistical test, it was found that the percentage of initial fat intake with a value of $p = 0.200$ and $p = 0.150$ in the percentage of final fat intake indicated that there was no difference in the percentage of fat intake in the intervention group and the control group ($p > 0.05$). So that the percentage of fat intake data used is comparable

Percentage of Fiber Intake

Soluble fiber can reduce total cholesterol and LDL cholesterol significantly, but not significantly in crude fiber. Soluble fiber has a higher effectiveness against cholesterol by binding to bile acids and increasing cholesterol excretion [18].

Cholesterol levels in the blood can be lowered by increasing the consumption of fermentable dietary fiber and causing high viscosity in the intestines [24]. Consumption of fermented food fiber can reduce cholesterol in the blood. Dietary fiber can more reduce cholesterol levels in the blood of hyperlipidemic sufferers, whereas in normal subjects, dietary fiber can lower triglyceride levels [18].

Based on the statistical test, it was obtained that the percentage of initial fiber intake with a value of $p = 0.446$ and $p = 0.174$ in the percentage of final fiber intake indicated that there was no difference in the percentage of fiber intake in the intervention group and the control group ($p > 0.05$). So that the percentage of fiber intake data used is comparable.

Effect of Intervention on Changes in Total Cholesterol Levels Before and After Intervention

In each group, the results obtained from the Independent T-test statistical test of total cholesterol levels before and after the intervention obtained a value of $p \leq 0.001$ ($p < 0.05$). This shows that there is a statistically significant change in the decrease in total cholesterol in the intervention and control groups.

After seeing changes in total cholesterol levels between the intervention group and the control group, the intervention group decreased significantly compared to the control group, this shows that Fermented Glutinous Black Rice can reduce total cholesterol levels. This is because Fermented Glutinous Black Rice has good anthocyanins to reduce total cholesterol levels in the body. In this study, the group that was given Fermented Glutinous Black Rice was given Fermented Glutinous Black Rice as much as 200 gr / day. The provision of 200 gr Fermented Glutinous Black Rice / day has fulfilled 51.4% of anthocyanin needs in a day.

In line with research conducted by Fauziyah, it is stated that routine consumption of Fermented Glutinous Black Rice has a protective effect against the incidence of metabolic syndrome [13] and

that consumption of Fermented Glutinous Black Rice > 11.5 grams per day has a protective effect against the risk of metabolic syndrome incidence of 0.09 times compared when the Fermented Glutinous Black Rice consumption is ≤ 11.5 grams per day [13].

Soltani's research also states that regular consumption of foods containing anthocyanins can significantly reduce total cholesterol, LDL, and triglycerides in hyperlipidemic patients [19].

The regulation of cholesterol synthesis in the body can be done at the beginning of the reaction pathway, namely at the stage of mevalonate formation by HMG-CoA reductase. The process of cholesterol biosynthesis can be inhibited by anthocyanins, which are antioxidants from phenolic compounds that can inhibit the HMG-CoA reductase enzyme that controls the cholesterol biosynthetic pathway in the liver, then inhibits the formation of mevalonates so that subsequent cholesterol synthesis steps can be inhibited and cholesterol formation can decrease [20]. This is in line with Asuzha Takashi's research, that consumption of foods containing anthocyanins can reduce blood fat and blood glucose [21]

The use of Fermented Glutinous Black Rice in this study in order to obtain the optimum state of anthocyanin, so that it can inhibit the formation of mevalonate into cholesterol. This is in line with Siregar's research which proved that there was a significant dynamic change in total anthocyanins during fermentation in grapes with a very high correlation ($r = 0.99$) [38], and Vongsudin's study with fermentation could increase antioxidant activity [22].

Consuming Fermented Glutinous Black Rice can reduce total cholesterol levels because it contains anthocyanins as a colored pigment in Fermented Glutinous Black Rice, and it is proven that Fermented Glutinous Black Rice is effective in reducing total cholesterol levels.

Conclusions and suggestions

The Fermented Glutinous Black Rice in this study was proven to reduce total cholesterol levels. Consumption of 200 grams of Fermented Glutinous Black Rice regularly can reduce total cholesterol levels significantly. This of course can increase prices and the positive effect of regional food as a functional food that should be preserved and utilized. Further research needs to be done to develop other variables that can affect total cholesterol levels, such as physical activity.

Thank-you note

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