

THE EFFECT FROM THE PROVISION OF PARIGI PINEAPPLE (*Ananas sp.*) JUICE TOWARDS THE TOTAL CHOLESTEROL LEVEL IN STUDENTS OF THE FACULTY OF MEDICINE, PALANGKA RAYA UNIVERSITY

Laras Efianty^{*1}, Donna Novina Kahanjak², Agnes Frethernety³, Lia Sasmithae⁴

¹Pendidikan Dokter, Fakultas Kedokteran, Universitas Palangkaraya, Indonesia

²Departemen Fisiologi, Fakultas Kedokteran, Universitas Palangkaraya, Indonesia

³Departemen Farmakologi, Universitas Palangkaraya, Indonesia

⁴Departemen Penyakit Dalam, Universitas Palangkaraya, Indonesia

*Corresponding Author:

Email: larasefianty4629@gmail.com, donnanovinakahanjak@gmail.com,
agnes@med.upr.ac.id, liasasmithae032@gmail.com

Abstract.

*Hypercholesterolemia refers to a risk factor for coronary heart disease which can occur on teenagers, such as medical students. A non-pharmacologically treatment which can be provided to lower one's cholesterol level is by utilizing Parigi pineapple (*Ananas sp.*). Its three main ingredients, namely Vitamin C, Niacin and Myricetin, are able to improve lipid profile. The purpose of this research is to determine the effect from the provision of Parigi Pineapple (*Ananas sp.*) juice towards the cholesterol level in students of the Faculty of Medicine, Palangka Raya University. This research applies a quasi-experimental with one group pre-test post-test design. The estimated sample size in this research is set by using the convenience sampling method. The research sample consists of 43 male and female students, from the academic year of 2020, Faculty of Medicine, Palangka Raya University. The research instruments are Cobas C111 cholesterol examination tool and a centrifuge stored in Medika laboratory; as well as juice-preparation tools (i.e. knives, food scales, measuring cups, blenders, glasses, as well as gloves). After providing Parigi Pineapple (*Ananas sp.*) juice for 6 days at a dose of 142gr/70 kg, a statistical test is conducted through Wilcoxon Test, at a significance level of $\alpha = 0.05$, in which the (*p*-value) obtained is 0.000. In other words, this shows that the average cholesterol level of the respondents have decreased; namely from 215.56 mg/dL to 179.53 mg/dL. The juice contains Vitamin C, Niacin and Myricetin, which can lower one's cholesterol level.*

Keywords: *Ananas sp.*, hypercholesterolemia, vitamin c, niacin, myricetin

INTRODUCTION

Hypercholesterolemia refers to a risk factor for coronary heart disease. Based on the Indonesia Basic Health Research 2018 (*Riskesdas*); approximately 36 million people (18% of Indonesia's total population) have hypercholesterolemia.¹ The prevalence of the data concerning the proportion of cholesterol level in the population of this country indicates that 7.2% of the age group of 15-24 years old, 14.7% of the age group of 25-34 years old, as well as 20.6% of the age group of 35-44 years old suffer from hypercholesterolemia.² The results from previous research on the secondary data collected from the Health Office of Kalimantan Tengah in 2020 show that hypercholesterolemia is in the 55th position. Moreover, the results from a research done by Malik *et al.*, also show that medical students from the academic year of 2011 in Sam Ratulangi University, Manado, suffer from hypercholesterolemia; with a high threshold of 200-239 mg/dL (25.80%) - precisely in 8 of 31 students.³

High cholesterol occurs on around 15% of teenagers. Its symptoms, specifically the ones which attack teenagers, tend to be ignored.³ One perfect example of this can be seen in the medical students' cases, whose majority of activities are at home, such as online lectures (during the Covid-19 pandemic). A research done by Gracia Natasia⁴ entitled, "An Overview of the Cholesterol Level in Overweight and Obese Students of the Faculty of Medicine, Sumatera Utara University", describes

the cholesterol level in her research subjects as terrible, where there are many medical students who suffer from obesity (32.4%) and overweight (12.7%) due to their lifestyle of consuming fast food.

Another research done by Isra Thristy *et al.*, entitled, "An Overview on Stress and HDL Cholesterol Level in Students of the Faculty of Medicine", shows that 54.2% of the whole research subjects have high cholesterol level as a result of increased stress. The latter condition may trigger a significant increase in cortisol, adrenaline, cholesterol, LDL cholesterol, as well as causing low level of HDL cholesterol.⁵

Lifestyle change is necessary to control one's cholesterol level; such as by dietary adjustments, daily exercise, avoiding smoking, and reducing stress.⁶ A non-pharmacologically treatment which can be provided to lower one's cholesterol level is by utilizing a particular fruit, namely Parigi pineapple (*Ananas sp.*). It is a fruit originating from South Barito Regency, Central Kalimantan. It contains three main ingredients which can improve lipid profile, namely Vitamin C, Niacin and Myricetin. The first is capable to improve lipid profile by forming bile via excretion of extrahepatic cholesterol. The second possesses an antidyslipidemic effect, which will hinder the deliverance of fat to the liver, hence reducing triglyceride synthesis. Finally, the last one, which is a type of flavonoid, is able to change the absorption of cholesterol, the assembly of triglyceride secretion, as well as the processing of plasma lipoproteins.⁷

According to the phenomenon and alternative therapy which is based on the aforementioned local variety, as well as according to the theories which underlie it; the researchers are therefore interested in doing a research on the effect from the provision of Parigi Pineapple (*Ananas sp.*) juice towards the cholesterol level in students of the Faculty of Medicine, Palangka Raya University.

METHODS

Tools and Materials

The tools used in this research are:

Cobas C111 Cholesterol examination tool and a centrifuge stored in Medika laboratory;

Juice-preparation tools (*i.e.* knives, food scales, measuring cups, blenders, glasses, as well as gloves).

The materials used in this research are:

- a. Materials to examine the blood samples that are stored in Medical Laboratory (*i.e.* cholesterol reagent, syringe, red blood tube, tourniquet, plaster, alcohol cotton, 3 cc syringe, 3 cc of respondent's blood serum, sample cup, as well as micropipette);
- b. The material used to make the juice, namely Parigi Pineapple (*Ananas sp.*), for as much as 142 gram / 70 kg weight / respondent. This fruit originated from Pararapak, Dusun Selatan District, South Barito Regency, Central Kalimantan.

This research applies a quasi-experimental with one group pre-test post-test design, in which a direct research is done on one group of subjects under two conditions that is performed without a comparison group; therefore each subject is a control class over itself. In this design, prior to the initiation of the treatment; the researchers perform a pre-test on the test group; precisely by measuring their initial cholesterol level. After that, the test group receives the treatment, namely given and asked to consume the Parigi Pineapple (*Ananas sp.*) juice. After the treatment is complete, the researchers perform a post-test, namely by measuring the respondents' final cholesterol level.

The identification process of Parigi Pineapple is done at the E-Science Service of the Indonesian National Research and Innovation Agency (ELSA BRIN). The plant is identified as a species of *Ananas comosus* (L.) Merr.

The main ingredients found in the plant are Vitamin C, myricetin, and niacin. The identification of the compounds contained in the pineapple is done at the Biochemistry Laboratory of the Faculty of Medicine, Lambung Mangkurat University, Banjarbaru. The samples delivered are Parigi Pineapple, Sampit Pineapple and Basarang Pineapple; whereas the contents identified are Vitamin C and myricetin. In the aforementioned site, it is not yet possible to identify the niacin compound in the fruit; hence only those two compounds are identified.

Furthermore, an ethical procedure is implemented after meeting the requirements, namely by submitting ethical approval to the Research Ethics Commission of the Faculty of Medicine, Palangka Raya University and have been approved for ethical clearance.

RESEARCH AND DISCUSSION

Total cholesterol refers to the amount of cholesterol contained in every cholesterol-carrying particle in the blood, such as HDL, LDL and VLDL. It is often, if not always, parallel with LDL level. Meanwhile, cholesterol is a steroid which lingers in concentrations which are usually assessed throughout the body. Most of the cholesterol needed by the body is synthesized endogenously from acetyl-CoA through β -methyl glutamyl-CoA. Cholesterol which is produced by the liver and delivered in plasma is referred to as LDL cholesterol. Meanwhile, cholesterol which is released from peripheral tissues and esterified in the plasma with fatty acids derived from lecithin by cholesterol lecithin will be transported to the liver and referred to as HDL cholesterol. The cholesteryl esters are usually delivered to other lipoproteins through exchange with triglycerides. Cholesterol level will increase with age and it will be higher in males (especially once they hit 50 years old). Finally, cholesteryl esters are 65-75% of plasma cholesterol.⁴

The type of pineapple used in this research is Parigi Pineapple, which originated from South Barito Regency. This research is continuing a previous research done by Fia (2018), which also uses Parigi Pineapple. The purpose of that research is to determine the effect from the provision of Parigi Pineapple juice towards the blood pressure in students of the Faculty of Medicine, Palangka Raya University. Moreover, it also suggests further research to be done regarding the ability of each compound contained in this particular plant towards other variables (other than to low blood pressure).²³ This plant is chosen for this research in a hope that this particular local variety of South Barito Regency can gain more recognition. Furthermore, this research is done based on the visible side; meaning a research in which the researchers have easy access to the research materials, and that the research cost is also cheap.

The characteristics of the respondents in this research consist of gender, age, body mass index (BMI), smoking habits, physical activity, as characteristics of the respondents are written in the following table.

Table 1. Characteristics of the Respondents

Variable	n	%
Gender		
Female	24	55,8
Male	19	44,2
Total	43	100
Age		
19 years old	12	27,9
20 years old	22	51,2
21 years old	8	18,6
23 years old	1	2,3

Variable	n	%
Total	43	100
Body mass index		
Underweight	3	7
Normal	13	30,2
Overweight	0	0
At risk	7	16,3
Obesity I	14	32,6
Obesity II	6	14
Total	43	100
Smoking habit		
Does not smoke	43	100
Smoke	0	0
Total	43	100
Physical Activity		
Light	35	81,3
Moderate	6	14
Heavy	2	4,7
Total	43	100
Exercise Intensity		
Seldom	17	39,5
1-2x/week	15	34,9
2-3x/week	9	20,9
3-5x/week	2	4,7
Total	43	100

The results of the research on the characteristics of respondents based on their gender are written in Table 5.1. From there, it is apparent that the majority of respondents who suffer from high cholesterol level are female, precisely 24 people (55.8%); whereas for male, it only happens in 19 people (44.2%). According to a research done by George, a young male or female who has undergone puberty will be at risk of hypercholesterolemia, due to the changes in his or her lipoprotein metabolism caused by an increase in the sex hormones, namely testosterone and estrogen. For females, both are important modulators of lipid metabolism, inflammation and vascular homeostasis. Furthermore, the two of them are also endogenous hormones which contribute to the low prevalence of vascular disease. Failing to have enough number of the two may cause insulin resistance, diabetes, dyslipidemia and arterial hypertension, as well as an increase in BMI - hence increasing the risk of obesity.⁸

Endogenous testosterone and estrogen are important modulators of lipid biosynthesis and oxidation. They can also stimulate hepatic HDL synthesis – yet they might slow the excretion of SR-B1 - hence prolonging the circulating HDL cholesterol level by disrupting its release. However, in teenagers (both male and female), the production can be affected by various factors, one of which is genetic factor; which contributes to lipid biosynthesis.⁹ Another research done by Holly mentions a case where a teenager already has abnormal cholesterol. It is surprising, however; it turns out that it is caused by obesity (OB). Another instance is that there are also people with familial hypercholesterolemia (FH), which is a genetic condition that can induce cholesterol. All of it are in accordance with this research, in which the factor which is responsible for the occurrence of hypercholesterolemia in the young respondents (teenagers) is most likely obesity. As many as 13

respondents are overweight (with ≥ 23 scoring), at risk (with 23-24.9 scoring), 14 respondents have type I obesity (with 25-29.9 scoring), and 6 respondents have type II obesity (with ≥ 30 scoring).¹⁰

According to a research done by Akhfiya, a female may possess a greater risk of having high cholesterol, which is often associated with hormonal risk factors (*i.e.*, decreased function and production of the hormone estrogen level). A decrease in the hormone estrogen will cause lipid products (or cholesterol level) to increase and invoke changes in body fat composition – which is related to hypercholesterolemia.¹¹ Similarly, Ujjani also argues that females can lose 30% - 50% of their total muscle mass at the age of 45. Due to the aging process, the body's metabolism will slow down. Furthermore, the low mobility will accelerate the substitution process between the muscle mass and the body fat. Decreased muscle mass can help to reduce calorie consumption; and most food, if not all, will be morphed to fat.¹²

Based on Table 5.1, the ages of the respondents of this research are around 19-23 years old. Therefore, another possible cause of hypercholesterolemia at their young age is their family condition (maybe their parents have high cholesterol), or their bad diet.¹³ This is supported by a research done by Ujjani, which mentions that hypercholesterolemia can be caused by bad diet (at a young age), genetic factors, environmental factors, health factors, drugs, physical activity, as well as psychological factors (stress). Another possibility is that the amount of female students are larger than the amount of the male students (for the academic year of 2020); in which this cannot be controlled by the researchers.

The results of the descriptive research on the characteristics of respondents based on their age are written in Table 1. It is apparent that the average age of people with high cholesterol is between 19-23 years old, where most of the "patients" are aged 20 years old. Age is the duration of life which is calculated based on one's date of birth (in this case, the respondents). According to Saputri and Novitasari, as people grow older, their arteries will be wider and stiffer. This in turn reduces the elasticity; hence causing the area influenced by systolic pressure to narrow, therefore the blood pressure increases. Meanwhile, cholesterol is a modifiable risk factor for hypertension, where higher cholesterol can result in hypertension.²¹ Moreover, other research state that as an individual grows older, his or her ability of low-density lipoprotein receptor will decrease; hence increasing the LDL level in the blood, which will result in coronary artery blockage. In short, as people grow older, their cholesterol level will also increase.¹⁰

Lipid metabolism can lead to lipid disorders. These disorders can be in the form of over-production of lipoproteins or decreased catabolism. The mechanisms which may cause the disorders to occur are such as abnormalities in LDL clearance; deficiency or reduction of apo B-100/E receptors (which leads to defective hepatic residual VLDL (IDL) clearance), and more IDL is morphed into LDL. In addition, LDL clearance is also reduced, hence increasing its concentration. Another mechanism is Lipolysis disorder. There are two factors which can damage lipolysis; the first being a decrease in the availability of Lipoprotein Lipase (LPL) in the respondents - which will increase the triglyceride-rich lipoproteins (especially chylomicrons), while the other factor is the possibility of abnormalities in lipoprotein itself. High triglycerides can be found in the "patients" who have defects in their apoprotein composition of triglyceride-rich lipoproteins. As for hypercholesterolemia, it can be found in the "patients" who inherit apo C-II disorder.¹⁵

The mechanism of lipids disorder is the abnormal removal of metabolic waste. Apo E plays a crucial role in removing the remnants of triglyceride-rich lipoprotein. Chylomicron receptors recognize Apo E, both the ones that lie on the remnants of chylomicron and the ones on large LDL. Apo E also emerges to remove the smaller remnants of VLDL through LDL receptor. Each individual inherits two genes for apo E - and around six genotypes. Individuals with these genotypes tend to accumulate the remnants of lipid metabolism, which will lead to diseases. Other mechanisms are also

found in the over-production of lipoproteins; where the latter condition, especially VLDL, is the cause of various types of dyslipidemia. Over-production of VLDL can be primary or secondary. A possible reason for the former is excessive apo B synthesis (without any production of VLDL), as well as excessive triglycerides, which may increase the secretion of VLDL. Meanwhile, for the latter, a carbohydrate-rich diet may stimulate VLDL and triglyceride synthesis.¹⁵

In this research, all of the respondents are still young, yet they already have high cholesterol. It is possible that the cause of it is their weight, bad diet, or stress (due to college). These results are reinforced by a research done by Ujiani, which argues that there is no relationship between age and cholesterol level. This means that all ages have similar risk of increased cholesterol level. This condition is also made possible by the consumption of foods with high cholesterol, which are widely consumed by the community, especially teenagers. A healthy diet is one of the factors which can either increase or decrease one's cholesterol level.¹²

Furthermore, table 5.1 also explains Body Mass Index (BMI) based on the classification of Asia Pacific BMI criteria; where 3 respondents are underweight (with a value of <18.5) and 14 respondents are normal (with a value of 18.5-22.9). Furthermore, as many as 13 respondents are overweight (with a value of ≥ 23), at risk (with a value of 23-24.9), 14 respondents have type I obesity (with a value of 25-29.9), and 6 respondents have type II obesity (with a value of ≥ 30). The majority of respondents suffer from type I obesity because they have infrequent physical activity. The researchers do not conduct further research regarding BMI's type I obesity on the respondents. The results of the Indonesia Basic Health Research 2018 (*Riskedas*) state that the lack of physical activity at the age of >10 years old can be the cause of BMI's type I obesity.¹ According to Hutami, who does a research on the BMI in students of the Faculty of Medicine, Sultan Agung Islamic University; the BMI which belongs to the overweight and obesity categories tend to reflect changes in one's body composition.¹⁶ This opinion is strengthened by another research done by Wahyuni, who examines the relationship between BMI and cholesterol level in medical students. She explains that an increase in BMI reflects an increase in the proportion of one's body fat mass. Although hypercholesterolemia usually affects overweight and elderly individuals, it can still attack teenagers due to their lifestyle.¹⁷

According to Alamsyah, every 1 kg/m² increase in BMI is related with a plasma cholesterol of 7.7 mg/dl and 0.8 mg/dl decrease in HDL cholesterol level. Many research show that obesity causes an endogenous cholesterol synthesis rate of 20 mg (daily) for every kilogram of excess weight, increased VLDL synthesis, as well as triglyceride production. Increased BMI or obesity can also increase the lipid deposits in the tissues, which in turn may affect the levels of free fatty acids in the blood. This can result in metabolic disturbance in the body; and this is the reason that LDL cholesterol level increases. Furthermore, it may affect the cholesterol level in the body as well.¹⁸

In this research, the whole respondents (100%) do not smoke. The chemicals contained in cigarettes can also increase LDL cholesterol level and reduce HDL cholesterol level. For smokers, the latter is usually low; meaning that its formation, which is responsible to deliver fat from the tissues to the liver, is disturbed. On the contrary, they usually have high LDL cholesterol level; meaning that the fat from the liver is delivered back to the body's tissues. The smoke which comes from tobacco is one of the substances that may disrupt the body's work and affect cholesterol metabolism. The unbalanced state between the decrease of HDL cholesterol level, the increase of LDL cholesterol level, as well as excessive VLDL (due to nicotine and other chemicals in a puff of cigarette) can affect one's cholesterol level.¹⁸

According to Minarti, the longer a person becomes a smoker, the greater the risk of disturbances in their serum lipid profile. A long-time smoker can have an increased LDL cholesterol level; that is induced by the accumulative effects of nicotine and free radicals. The former can last in one's body for more than 12 hours. Meanwhile, cotinine is the main metabolite of nicotine and has a

half-life of 15-40 hours in one's body. Any exposure to chemical metabolite and free radicals from cigarettes may invoke disorders in one's serum lipid profile.¹⁹

The results in Table 1 also explain that the respondents of this research have infrequent physical activity. Moreover, their exercise intensity is also low. This results are in accordance with the data from Indonesia Basic Health Research 2018 (*Riskedas*).¹ This is similar with a research done by Aditya, which mentions that increased physical activity can affect one's cholesterol level (precisely by increasing the need for ATP - hence increasing the metabolism of Acetyl-CoA to ATP instead of metabolize it to cholesterol). Frequent physical activity can accelerate the breakdown of triglycerides (namely by inducing the adipose triglycerol lipase (ATGL), hormone-sensitive lipase (HSL) and monoglyceride lipase (MGL) enzymes - hence decreasing the VLDL, which is a component of total cholesterol, therefore decreasing hypercholesterolemia).²⁰

The results of the descriptive analysis are in accordance with the observations made during the research on total cholesterol, prior to the administration of the pineapple juice, in which most of the respondents experience an increase in their cholesterol level due to several factors outside of the research (which are beyond the control of the researchers, *e.g.* bad diet, obesity, smoking habit, low intensity of physical activity, as well as stress due to college).

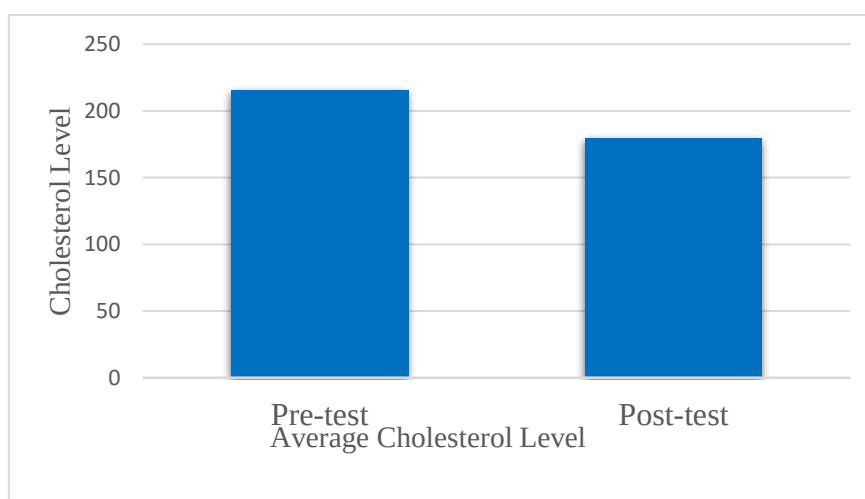


Figure 1. The Average Value Pre-test and Post-test the Provision of Parigi Pineapple Juice

Based on Figure 1, it can be seen that most respondents' cholesterol level manage to decline, with a pre and post difference of 36.03 mg/dL (from an average of 215.56 mg/dL to 179.53 mg/dL).

This research proves that the cholesterol level in the students of the Faculty of Medicine, Palangkaraya University (Academic Year of 2020) manage to decline after they consume Parigi pineapple juice, as shown in Figure 1. where the average cholesterol level (post-treatment) is 179.53 mg/dL. This shows that Parigi pineapple juice is quite effective in reducing the cholesterol level in people with hypercholesterolemia. The effect of that particular treatment on the cholesterol level has been tested statistically through Wilcoxon test, at a significance level of $\alpha = 0.05$, combined with the help of SPSS 26 statistics, where a (p-value) of 0.000 is obtained. Since the (p-value) is smaller than the (α); therefore H1 is accepted. This indicates that there is a difference between the total cholesterol during the pre-test and post-test, thus it can be concluded that Parigi Pineapple (*Ananas sp.*) juice can reduce cholesterol level.

This research proves that the provision of Parigi Pineapple (*Ananas sp.*) juice significantly affects the decrease of one's cholesterol level (p-value <0.05), where the mechanisms are such as delaying the absorption of cholesterol in the small intestine, delaying cholesterol synthesis in the

liver, delaying the deliverance of fatty acid, as well as increasing the excretion of cholesterol. The extract of the pineapple consists of vitamin C, niacin and myricetin; which are able to improve the lipid profile. The first can do it by forming bile via excretion of extrahepatic cholesterol. Furthermore, in a large dose, the latter has an antidyslipidemic effect. Therefore it can reduce cholesterol and free fatty acids in the blood. It will also hinder the deliverance of fat to the liver, hence reducing triglycerides synthesis.²¹

Since pineapple contains Vitamin C, it can prove useful for the metabolism of cholesterol, namely by increasing the rate where the cholesterol is disposed of (in the form of bile acids) - which will be excreted through the small intestine. Moreover, it can also increase HDL cholesterol (which transport LDL cholesterol), as well as become a laxative - hence increasing defecation.²²

The utilization of traditional medicine has become some sort of a culture which is passed down for thousands of years. One of the most-frequently used natural ingredients is pineapple. Indonesians have been using it as an anthelmintic.⁷ Moreover, this particular fruit is also considered to be able to reduce high blood pressure and cholesterol level; making them able to prevent stroke, possess a diuretic effect, reduce fever, as well as to accelerate the elimination of toxins and wound healing. Furthermore, it is also a source of natural oxidants which can increase the body's immunity against infectious diseases, as well as increase leukocytes concentration.⁷

Ananas sp. - or also known as Parigi Pineapple (Figure 2.) - belongs to the Bromeliaceae family. This plant originated from Barito Selatan, Kalimantan Tengah. Other research which also support the effectiveness of this fruit state that it contains polyphenolic compound, which is flavonoid. It can improve lipid profile, since flavonoid can delay the absorption of fat. Besides being antidyslipidemic, it is also a renowned antihistamine, anti-cancer, as well as cardioprotective. It contains myricetin, kaempferol, luteolin, apigenin and quercetin. The first can improve lipid profile by morphing the absorption of liver, the assembly and the secretion of triglycerides, as well as the processing of plasma lipoproteins.⁷



Figure 2 Parigi Pineapple

In addition, polyphenols can increase HDL cholesterol, namely by increasing the paraoxanase enzyme. Other ingredients which are considered to be able to improve lipid profile are vitamin C and niacin. The former improves it by forming bile via excretion of extrahepatic cholesterol. Meanwhile, in a large dose, the latter can lower cholesterol and free fatty acids in the blood. It is famous as a treatment for dyslipidemia. It will delay the deliverance of fat to the liver, hence reducing triglycerides synthesis. This is in accordance with the results of a scientific research done by Sanggih *et al.*, where it finds that increasing the dose of the extract of pineapple can reduce cholesterol, triglycerides and LDL cholesterol.⁷

This research is recommended to be used as an additional information for the respondents, who are expected to consume pineapple juice often, so as to reduce their cholesterol level to normal.

This research is also recommended to be used as a discourse and guide to give similar treatment for the people with high cholesterol. From the discussion, it can be concluded that the provision of Parigi pineapple (*Ananas sp.*) juice significantly affects the shifts in the cholesterol level. Therefore, it can serve as a non-pharmacological treatment for people with hypercholesterolemia.

CONCLUSION

The following conclusions are drawn from this research by the researchers:

1. During the pre-treatment period, the cholesterol level of the respondents are high, in which the average value is 215.56 mg/dL. Meanwhile, during the post-treatment period, their cholesterol level manage to decline, in which the average value is 179.53 mg/dL.
2. Parigi Pineapple (*Ananas sp.*) juice can reduce cholesterol level.

ACKNOWLEDGEMENT

This research is the result of independent research by student and lecturers of the Medical Education Study Program, Faculty of Medicine, University of Palangka Raya, Central Kalimantan.

REFERENCE

- Kepel BJ. Prevalensi hiperkolesterolemia pada remaja obes di Kabupaten Minahasa. *J e-Biomedik*. 2016;4(1).
- Tim Riskesdas 2018. Laporan Nasional Riskesdas. Vol. 10, Riset Kementerian Kesehatan RI. Jakarta; 2018.
- Talumewo M, Tiho M, Paruntu ME. Gambaran Kadar Kolesterol Total Darah pada Mahasiswa Fakultas Kedokteran Universitas Sam Ratulangi dengan Indeks Massa Tubuh ≥ 23 Kg/M². *J e-Biomedik*. 2018;6(2).
- Natasia G. Gambaran Kadar Kolestrol Total Pada Mahasiswa Overweight Dan Obesitas di Fakultas Kedokteran Universitas Sumatera Utara. 2016;7–37.
- Thristy Isra, Mardia Rina Sari, Mampatdi Cut Mutia, Chan MZK. Gambaran Tingkat Stres dan kadar HDL Kolesterol Darah Pada Mahasiswa Fakultas Kedokteran. *J Pandu Husada*. 2020;1(3):149.
- Zuhrawati NA. Pengaruh Pemberian Jus Nanas (*Ananas comosus*) Terhadap Kadar Kolesterol Total Darah Kelinci (*Orytolagus cuniculus*) Hiperkolesterolemia. *Med Vet ISSN* 0853-1943. 2014;8(1):76–9.
- Sangghih Putu Ristyaning Ayu, Wahyudo R, Ginarana A. Efek Buah Nanas (*Ananas comosus* L. merr) Terhadap Penurunan Kadar Kolesterol Pada Penyakit Jantung Koroner (PJK) The Effect of Pineapples (*Ananas comosus* L. merr) on Decreasing Cholesterol Levels in Coronary Heart Disease. *Jk Unila*. 2019;3(1):205–9.
- Robinson GA, Peng J, Peckham H, Radziszewska A, Butler G, Pineda-Torra I, et al. Sex hormones drive changes in lipoprotein metabolism. *iScience*. 2021;24(11).
- Barton M. Cholesterol and atherosclerosis: Modulation by oestrogen. *Curr Opin Lipidol*. 2013;24(3):214–20.
- Gooding HC, Sheldrick RC, Leslie LK, Shah S, de Ferranti SD, Mackie TI. Adolescent Perceptions of Cholesterol Screening Results: “Young Invincibles” or Developing Adults *J Adolesc Health* 2016;59(2):162–70.
- Akhfiya M, Syamsianah A, Mufnaetty. Kadar Kolesterol Total Wanita Menopause Hiperkolesterolemia Sesudah Pemberian Teh Buah Tin. *J Gizi*. 2018;7(2):49–53.
- Sri U. Hubungan antara Usia dan Jenis Kelamin dengan Kadar Kolesterol Penderita Obesitas

- RSUD Abdul Moeloek Provinsi Lampung. *J Kesehatan*. 2015;6(1):43–8.
- Sihotang HT. Sistem Pakar Mendiagnosa Penyakit Kolesterol Pada Remaja Dengan Metode Certainty Factor (Cf) Berbasis Web. *J Mantik Penusa*. 2014;15(1):16–23.
- Saputri DA, Novitasari A. Hubungan Usia Dengan Kadar Kolesterol Masyarakat Di Kota Bandar Lampung. *BIOEDUKASI (Jurnal Pendidik Biol*. 2021;12(2):238.
- Bereda G. Pathophysiology and Management of Dyslipidaemia. *BioMedical*. 2022;43(2):34369–75.
- Hutami AT, Ratnawati, Wahyuningsih H. Hubungan Antara Indeks Massa Tubuh dengan Kadar Kolesterol (Studi Observasional Analitik Pada Mahasiswa Fakultas Kedokteran Universitas Islam Sultan Agung Angkatan 2015). *Pros Konf Ilm Mhs Unissula 2*. 2019;12.
- Shabah ZM, Dhanny DR. Persepsi Tubuh dan Bulimia Nervosa pada Remaja Putri. *Muhammadiyah J Nutr Food Sci*. 2021;1(2):48.
- Alamsyah MNUR. Tubuh Dengan Kadar Kolesterol Total Pada Anggota Korem 074 Warastratama Surakarta. 2018.
- Minarti SN, Ketaren I, Hadi DP. Hubungan Antara Perilaku Merokok terhadap Kadar Kolesterol. *Untan*. 2014;1(1):1–17.
- Aditya T. Hubungan Aktivitas Fisik Dengan Kejadian Hiperkolesterolemia Pada Populasi Dewasa Di Dusun. 2018.
- Octadiani Putri Latifa, Hermayanti D, S F. Pengaruh Pemberian Ekstrak Buah Nanas (*Ananas comosus* L. Merr) Peroral Terhadap Perbaikan Profil Lipid Pada Tikus Putih (*Rattus norvegicus*) Jantan Strain Wistar Dislipidemia. *Saintika Med*. 2017;9(1):25.
- Moudika Arina Yosi, Rijai Akhmad Jaizzur, Annisa NF. Observasi Klinik Pemberian Jus Nanas (*Ananas Comosus* L. Merr) Dalam Menurunkan Kadar Kolesterol. *Angew Chemistry Intd* 6(11), 951–952. 201827.