Red Dragon Fruit (*Hylocereus Polyrhizus*) to Reduce Cholesterol Level in People With Excessive Nutritional Status

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Abstract

Background: Nutritional status is closely related to high cholesterol levels. High cholesterol levels as a trigger for other metabolic diseases. Fruits high in fiber and vitamin C can be used to keep blood cholesterol levels regularly.

Aim: To determine the effect of red dragon fruit on blood cholesterol levels in people with excessive nutritional status.

Methods: Research used an experimental approach with a pretest and post-test control group design. The sample consisted of 2 groups, namely the control group and the intervention group, with 50 respondents in each group. The sample was taken using purposive sampling. The intervention group got red dragon fruit juice for seven days. Blood cholesterol levels are measured by laboratory tested using intravenous blood. The statistical test used the Paired T-Test and Independent T-Test.

Results: The difference mean posttest-pretest control group and intervention groups were 13.56 mmHg and -13.06 mmHg. The analysis of pretest-posttest blood cholesterol levels among the control and intervention groups were p=0.514 and p=0.035. The difference between the control group and the intervention group was 0.022.

Conclusion: Red dragon fruit is effective in reducing blood cholesterol levels in people with excessive nutritional status.

Keywords*: Cholesterol, Hylocereus polyrhizus, obesity, overweight, phytotherapy.*

Introduction

The incidence of obesity in the world has doubled since 1980. Worldwide in 2014, it showed that> 1.9 billion adults aged> 18 years were overweight, of which> 600 million people were obese. The highest prevalence of overweight is in the United States, and the lowest is in the South-East Asia region.[1] Indonesia's 2018 basic health research shows that from 2007 to 2018, the proportion of overweight in adults aged> 18 years has increased, from 8.6% to 13.6%. The ratio of obesity at age> 18 years from 2007 to 2018 has also increased, namely 10.5% to 21.8%.[2] Nutritional status is more capable of leading to dyslipidemia, an increased risk of coronary heart disease (CHD), diabetes mellitus, and other serious diseases. More nutritional status is also closely related to dyslipidemia, one of which is high cholesterol levels. [3,4,5]

Cholesterol is one of the most important substances in the human body. There are two types of cholesterol in the blood, namely bad cholesterol and good cholesterol.[6] Bad cholesterol in the body is Low-Density Lipoprotein (LDL) cholesterol, triglycerides, and lipoproteins. High-Density Lipoproteins (HDL) is a type of good cholesterol that is harmless in the body. Normal total cholesterol levels in the blood are less than 200 mg/dL or 160-200 mg/dL.[7] High blood cholesterol levels

in the long term are bad for the body. Long-term LDL buildup causes atherosclerosis, which blocks blood flow and is an indicator of heart disease risk.[8] World Health Organization data shows that 17 million people (31%) each year die from Cardiovascular Diseases (CVDs) worldwide.[9] The prevalence of heart disease in Indonesia in 2018 reached 1.5%.[2] Management to prevent the accumulation of cholesterol levels in the can use pharmacologic and non-pharmacological treatments.

It decreased cholesterol levels with a nonpharmacologic diet combined with herbal medicines or components of active substances in fruits or vegetables. One of the fruits that can lower cholesterol levels is dragon fruit. Dragon fruit is rich in antioxidants (anthocyanins, polyphenols, vitamin C, vitamin E) and is high in fiber.[10] Dragon fruit can reduce total cholesterol, triglycerides, and LDL cholesterol levels in rats with hypercholesterolemia, dyslipidemia, and diabetes mellitus. [11,12,13]

Dragon fruit is a plant that is easy to grow and cultivate in Indonesia. Dragon fruit is also cheap and easy to consume. Researchers are interested in examining the benefits of dragon fruit on cholesterol levels. Based on the results of a preliminary study, people with excessive nutritional status are found. After measuring cholesterol levels in these 10 people, there were 6 people with cholesterol levels> 200mg/dL, 2 people with cholesterol levels> 190mg/dL (<200mg/dL) and 2 people with cholesterol levels of 178mg/dL. The results of other interviews were as many as eight people who did not make good pharmacological or non-pharmacological efforts. One person had consumed cholesterol-lowering drugs, and one person took herbal medicine for approximately six months.

Methods

1. Study Design and Participants

This study used a experimental approach with a pretest and post-test control group design. The study was conducted on excessive nutritional status in the Kebumen, Central Java, Indonesia, in June 2020. The independent variable was dragon fruit juice. The dependent variable is the total cholesterol level. The sample consisted of 2, namely the control group and the intervention group. The control group did not get any treatment, while the intervention group received dragon fruit juice. The number of samples in each group was 50 people who were selected by purposive sampling method. The inclusion criteria were age 20-60 years, BMI ≥25.0, and willingness to become respondents. The exclusion criteria were smoking, consuming alcohol, consuming cholesterol medication, consuming vitamin C regularly, consuming high fiber fruit regularly, diabetes mellitus, and gastritis. The drop-out criterion does not follow the research process from the beginning or the first day to the last day.

During the research process, the respondents were arranged in their diets and activities. Respondents got a diet of carbohydrates and protein. Respondents are not allowed to consume foods high in fat. The activities that are allowed are light and moderate. Select samples of excessive nutritional status by measuring height and weight directly, then calculating BMI. The digital weight scales used have been tested for calibration at the Legal Metrology Unit of Yogyakarta City with the certificate number 212/MET/TE-72/II/2020. Microtoice has conducted a calibration test at the Legal Metrology Unit of Yogyakarta City with certificate number 212/MET/UP- 20/II/ 2020.

2. Instruments and Data Collection

The intervention group was given dragon fruit juice. Red dragon fruit juice is a fruit drink made by separating the skin's red dragon fruit flesh. The red dragon fruit flesh was weighed using a digital food scale with a dose of 2.86 g / kg. Then it is blended for about 30 seconds with the addition of water as much as +/- 70 ml without adding sugar. The red dragon fruit that has been blended is put into a drinking glass and is directly consumed by the respondents. Dragon fruit juice is given once a day for 7 days and is given in the afternoon at 16.00-17.00 WIB on an empty stomach or a maximum of lunch around 12.30 WIB. Dragon fruit juice was made directly

in front of the respondents so that it was consumed fresh.

Total cholesterol level is the total amount of cholesterol in the blood measured using a digital cholesterol test strip or an auto check. Cholesterol tests were carried out in the peripheral blood vessels or one of the respondent's fingertips, namely the index, middle, and ring fingers, previously disinfected. Cholesterol levels were measured pretest and post-test in the morning around 07.00-09.00 WIB or after respondents had fasted for approximately 9-12 hours. Cholesterol levels were measured using a three cc median cubital vein and checked in the laboratory. The pretest cholesterol levels were measured on day one before the intervention. Post-test cholesterol levels were measured after the respondent was given intervention for seven days or was carried out on the 8th day. Sampling blood was carried out according to standard operating procedures. The data is recapitulated in the observation sheet.

3. Data Analysis and Ethical Consideration

All respondents stated their willingness to become respondents by signing informed consent. The research was conducted after obtaining an ethical clearance letter with letter number 084.3/FIKES/PL/III/2020 and research permit number 900.2/FIKES/PL/V/2020. Univariate data were presented with minimum, maximum, mean, and frequencies-percentages for categorical variables. Before the bivariate test, the normality test was carried out using the Shapiro-Wilk test. The results showed that the data were normally distributed ($p > 0.05$) to analyze the pretest and post-test; each group used a Paired T-Test. The differences between groups were measured using the Independent T-Test.

Results

1. Sample Characteristic

Table 1 Relationship between Characteristics of Respondents and Total Pretest Cholesterol Levels in people with excessive nutritional status

Variable	∑	Total Pretest Cholesterol Levels (mg/dl)					p-value
		Min	Max	SD	Mean	Difference Mean	
Age							
Adult	24	113	233	36.19	179.31	5.22	0.010*
Elderly	12	152	287	39.04	184.53		
Gender							
Men	2	171	233	32,31	202.00	17.47	0.883*
Women	34	113	287	39.04	184.53		
Nutritional Status							
Overweight	11	113	239	41.83	183.88	0.15	0.695*
Obesitas	25	114	287	40.06	184.03		

∑=Number Min=Minimum Max=Maximum SD=Standard Deviation

*Tested using Pearson

Table 1 shows that most of the respondents are adult, female, and have an obese nutritional status, namely 24 people (66.67%), 34 people (94.44%), and 25 people (69.44%). The bivariate test results between age, sex, and nutritional status with the pretest value of cholesterol levels were p=0.010, p=0.883, and p=0.695. The results showed a significant relationship between age and pretest cholesterol levels, while gender and nutritional status had no significant relationship.

2. Differences in Characteristics of Respondents with Changes in Cholesterol Levels Pretest-Posttest

Table 2 Differences in Characteristics of Respondents and Changes in Cholesterol Levels at Pretest-Posttest in people with excessive nutritional status

Variable	∑	Cholesterol Levels at Pretest-Posttest (mg/dl)					p-value
		Min	Max	Mean	Difference Mean	SD	
Age							
Control Group							
Adult	13	114-132	233-214	170,38-171,69	1,31	33,29-22,83	0.276**
Elderly	5	152-206	226-276	195-257	62	37,11-34,03	
Intervention Group							
Adult	11	113-131	233-227	178,36-165,73	-12,63	38,79-26,88	0.133**
Elderly	7	178-182	287-236	224,14-210,43	-13,71	34,02-21,74	
Gender							
Control Group							
Men	0	0	0	0,0	0,0	0,0	0.307**
Women	18	114-132	233-276	174,83-188,39	13,56	32,31-39,19	
Intervention Group							
Men	2	171-165	233-190	202,00-177,50	-24,5	43,84-17,68	0.121**
Women	16	113-131	287-235	195,44-183,81	-11,63	43,94-34,86	
Nutritional Status							
Control Group							
Overweight	2	171-171	178-183	174,50-177	2,5	4,95-8,49	0.302**
Obesitas	16	114-132	233-276	174,88-189,81	14,93	34,37-41,43	
Intervention Group							
Overweight	8	113-147	239-235	194,12-195,62	1,5	39,97-30,37	0.132**
Obesitas	10	114-131	287-235	197,80-173,10	-24,7	46,81-33,16	

∑=Number Min=Minimum Max=Maximum SD=Standard Deviation

**Tested using Paired Samples Test

Table 2 shows the results of differences in respondents' characteristics with changes in cholesterol levels in the pretest and post-test in each group. There was no difference between adults and the elderly in the control and intervention groups with changes in pretest-posttest cholesterol levels with p=0.276 and p=0.133. Although statistically there is no difference, seen from the difference between the mean posttest-pretest in the control group, it shows that the elderly have increased cholesterol levels more than adults (62 mg/dl> 1.31 mg). Whereas in the intervention group, the reduction in cholesterol levels in the elderly was more than in adults (13.71 mg/dl> 12.63 mg/dl).

Judging from gender, in the control and intervention groups, there was no difference between men and women with changes in pretest-posttest cholesterol levels with p=0.307 and p=0.121. Although statistically, there is no difference, seen from the results of the mean posttest-pretest difference in the intervention group, it shows that there is a decrease in cholesterol levels more than women (24.5 mg/dl> 11.63 mg). Based on nutritional status, there was no difference between overweight and obesity in the control and intervention groups with changes in pretest-posttest cholesterol levels with p=0.302 and p=0.132. Although statistically, there is no difference, seen from the difference between the mean post-test-pretest in the control and intervention groups, there is a decrease in cholesterol levels more than overweight.

3. Effects of Red Dragon Fruit on Cholesterol Level

Table 3 The Effect of Red Dragon fruit (Hylocereus Polyrhizus) to reduce blood cholesterol level in people with excessive nutritional status

Cholesterol level (mg/dl)	Control Group		Intervention Group	
	Pretest	Post-test	Pretest	Post-test
Min	114	132	113	131
Max	233	276	287	235
Mean ±SD	173,5±32,311	181,5±39,193	196,17±42,674	181,11±33,086
Difference mean	13.56		-13.06	
Pvalue***	0,514		0.035	
Pvalue****	0.022			

*** *Paired T-Test*

*** **Independent T-Test*

Table 3 shows an increase in the average cholesterol level between the pretest and post-test in the control group, which was 13.56 mg/dl. In contrast, there was a decrease in cholesterol levels between the pretest and post-test in the intervention group, as much as 13.06 mg/dl. The bivariate test results in the control group obtained p=0.514, indicating no difference in cholesterol levels in the pretest and post-test. The intervention group showed red dragon fruit juice on total cholesterol levels in people with excessive nutritional status with p=0.035. The comparison between the control group and the intervention group obtained p=0.022, indicating a difference in the two groups, namely, the intervention group had a decrease in cholesterol levels.

Discussion

Cholesterol is one of the most important fat components in the body, found in cell membranes in all body tissues. Cholesterol is produced naturally by the body, namely in the liver, which builds cell walls and makes hormones. Apart from being produced naturally by the body, cholesterol is also obtained from the food consumed daily. Total cholesterol is the total amount of cholesterol in the body, namely High-Density Lipoprotein (HDL), Low-Density Lipoprotein, and other lipid components. The range of normal values for total cholesterol levels in the body has 3 categories, namely normal values <200mg/dl, high enough 200-239 mg/dl, and high cholesterol levels> 240 mg/dl.[14,15] Measuring total cholesterol levels on the first day and the eighth day when the respondent has fasted for approximately 9-12 hours. Researchers gave red dragon fruit juice with a fruit pulp dose of 2.86 g/kg body weight for each person. This dosage is following the results of previous studies.[12]

Total cholesterol levels in the blood can be influenced by several factors, namely genetic factors, diet and lifestyle, body weight, age, physical activity, smoking, and certain diseases.[16] This study did not consider all the risk factors that affect cholesterol levels in this study, only attention to age, gender, and the problem of nutritional status. Respondents are not allowed to consume high-fat foods during the study because it will affect the results The content of foods that contain cholesterol is fried, meat, brain, offal (intestines, liver, kidney, lungs, heart), egg yolk, seafood. Cholesterol in the body is also produced by the liver.[17]

Table 1 shows that the mean pretest cholesterol level in the elderly is higher than that of adults with a 5.22 mg/dl difference. The bivariate test results show a significant relationship between age and cholesterol levels (p=0.010). Increasing age is a factor in improving cholesterol levels. Cholesterol levels tend to grow at the age of more than 20 years. With age, there will be an increase in LDL production and a decrease in the level of fractional clearance of LDL, responsible for the rise in blood cholesterol levels in the long term.[18] Previous studies show that cholesterol levels get higher with age.[19,20] This study's results do not support the survey results. There is no relationship between age and cholesterol levels, where all ages risk increasing cholesterol levels.[21]

At the start of menopause, cholesterol levels begin to fall in women, and after that, cholesterol levels will increase as in men. After 50 years, cholesterol levels in men tend to continue to grow.[22] This is consistent with the study results, although the number of men but the mean cholesterol level of men was higher by a difference of 17.47 mg/dl. Statistically, there was no relationship between gender and cholesterol levels in respondents (p=0.883), supporting previous studies with the results that there was no relationship between sex and cholesterol levels (p=0.847). The absence of a relationship in this study was due to an unbalanced ratio between men and women. The majority of the study samples were adults and had not yet menopause.

Table 1 shows that the higher the BMI value, the higher the mean total cholesterol level but does not reach the cholesterol level limit in the reasonably high category (> 200 mg/dl). However, statistically, there is no relationship between excess nutritional status and cholesterol levels (p=0.695). Excess weight can harm health. Being overweight can raise triglyceride levels and lower HDL[17]. Biochemical disturbances can also occur due to excess nutrition or obesity, which causes an increase in cholesterol, triglyceride, blood sugar, and insulin levels.[23] The study results supported previous studies: there was no relationship between excess nutritional status and total cholesterol levels.[4,24]

Table 2 shows no difference in respondents characteristics with changes in cholesterol levels post-test-pretest in all aspects. This indicates that cholesterol levels in the control and intervention groups are not influenced by age, sex, and nutritional status. Table 3 shows the pretest value of total cholesterol levels between the control and treatment groups, namely the minimum value and the mean value in the normal

category. In contrast, the maximum value is categorized as high enough and in the high class. So it can be interpreted that respondents with nutritional status in this study had an average total cholesterol level in the standard type (<200 mg/dl). The results also showed the same effects on total cholesterol levels post-test in the control and treatment groups. The minimum value and the mean value indicate typical values. In contrast, the maximum value is included in the high category in the control group and the intervention group's high enough category. The minimum, maximum, and mean values in the intervention group were lower than in the control group.

Table 3 shows a difference between the pretest and post-test total cholesterol values in the intervention group (p=0.035) and is strengthened by a decrease in the mean value of 13.06 mg/dl. Meanwhile, the control group showed no significant difference between the pretest and post-test total cholesterol levels (p=514), and there was an increase of 13.56 mg/dl. This indicates that dragon fruit juice is effective in reducing cholesterol levels in people with excessive nutritional status. The research supports previous studies that red dragon fruit juice on total cholesterol levels in hypercholesterolemic men and women with diabetes mellitus.[12,13]

Red dragon fruit contains many substances that are beneficial to health. Dragon fruit content is rich in antioxidants (anthocyanins, polyphenols, vitamin C, and vitamin E) and high fiber content, which controls blood cholesterol levels.[10]. The content in 100 grams of red dragon fruit is 10.1 grams of fiber and 9.4 mg of vitamin C. The fiber content in dragon fruit can reduce fat absorption, especially cholesterol, to lower cholesterol levels. In this case, the long-term effect can provide benefits in preventing heart attacks and strokes. High fiber content can reduce cholesterol in the blood by inhibiting the re-absorption of bile acids in the intestine as compensation for the liver to synthesize more bile acids and require cholesterol. The liver will multiply receptors to capture cholesterol from the blood.[12,25]

Vitamin C plays a role in cholesterol metabolism, which increases the rate of removal of cholesterol removal in the form of bile acids, increases HDL levels, and plays a role in reducing bile acids' re-absorption. The content of vitamin C in dragon fruit can prevent coronary heart disease by inhibiting LDL oxidation, and vitamin C have the effect of avoiding HDL damage due to lipid peroxidase, free radical formation, and increased bile acid excretion.[26,27,28] The anthocyanin content of 8.8 mg/100gr is useful for reducing the risk of cardiovascular disease. The anthocyanin content in dragon fruit can also provide a cholesterol-lowering effect by inhibiting CETP and inhibiting the HMG-CoA reductase enzyme. Therefore, cholesterol concentrations in the liver and plasma are expected.[11,29] Nurses can promote complementary therapies through consumption of red dragon fruit which is used to keep blood cholesterol levels normal. This can be used as a preventive measure in the occurrence of other diseases.

This study had several constraints. The difficulty in this research is maintaining the freshness of the juice to be given. Good juices are those that are made and consumed at a distance of no more than 2 hours. To overcome this, the researchers prepared the juice directly in front of the respondents.

Conclusion

The results showed that red dragon fruit effectively reduced total cholesterol levels in people of excessive nutritional status. This study's results can further increase the intake of healthy nutrients from fruit to keep cholesterol levels regular. Normal cholesterol levels can prevent dangerous metabolic diseases.

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References

[1] Kementerian Kesehatan RI. FactSheet Obesitas Kit Informasi Obesitas 2014:1–8. http://p2ptm.kemkes.go.id/ uploads/N2VaaXIxZGZwWFpEL1VlRFdQQ 3ZRZz09/ 2018/02/ FactSheet_ Obesitas_Kit_ Informasi_Obesitas.pdf. (accessed November 1, 2020).

[2] Kementerian Kesehatan RI. Hasil Utama Riskesdas Penyakit Tidak Menular 2018. http://www.kesmas.kemkes.go.id/assets/upload/dir_519d41d8cd98f00/files/Hasil-riskesdas-2018_1274.pdf.

[3] Sukmaningrum PS. Hubungan Status Gizi dengan Kadar Kolesterol Total Pada Masyarakat Di Kelurahan Bahu Kecamatan Malalayang Manado. J Teknol 2013;1:69–73. https://doi.org/10.11113/jt.v56.60.

[4] Nugraha A, Widyatmoko S, Lestari N. Hubungan Indeks Massa Tubuh dengan Kadar Kolesterol Total pada Guru dan Karyawan SMA Muhammadyah 1 dan 2 Surakarta. A Cell Press J 2014;3. https://doi.org/10.1016/j.cell.2009.01.043.

[5] Rambod M, Ghodsbin F, Moradi A. The Association Between Body Mass Index and Comorbidity, Quality of Life, and Cognitive Function in the Elderly Population. IJCBNM. 2020;8(1):45-54. doi: 10.30476/IJCBNM.2019.81677.0

[6] The GBD 2015 Obesity Collaborators. Health Effects of Overweight and Obesity in 195 Countries over 25 Years. N Engl J Med 2017;377:13–27. https://doi.org/10.1056/NEJMoa1614362.

[7] Carson et al. Dietary Cholesterol and Cardiovascular Risk: A Science Advisory From the American Heart Association. Circulation, 2019;141:e39–53. https://doi.org/10.1161/CIR.0000000000000743.

[8] Soliman GA. Dietary Cholesterol and the Lack of Evidence in Cardiovascular Disease. Nutrients 2018;10:780. https://doi.org/10.3390/nu10060780.

[9] World Health Organization. Global Brief on Hypertension: Silent Killer, Global Public Health Crisis. Indian J Phys Med Rehabil 2013. https://doi.org/10.5005/ijopmr-24-1-2.

[10] Fadlilah E al. Dragon Fruit (Hylocereuspolyrhizus) Effectively Reduces Fasting Blood Sugar Levels and Blood Pressure on Excessive Nutritional Status. Pakistan J Med Heal Sci 2020;14:1402–12. https://pjmhsonline.com/2020/apr-june/1405.pdf.

[11] Werdiningsih W, Suhartati S. Effects Of Red Pitaya (Hylocereus Polyrhizus) On Lipid Profile Of Male White Rats (Rattus Norvegicus) Receiving High Fat Diet. Folia Medica Indones 2018;54. http://dx.doi.org/10.20473/fmi.v54i1.8046.

[12] Budiatmaja AC, Noer ER. Pengaruh Pemberian Jus Buah Naga Merah (Hylrocereus Polyrhizus) Terhadap Kadar Kolesterol Total Pria Hiperkolesterolemia. J Nutr Coll 2014;3:655–664. https://doi.org/uhttps//ejournal3.undip.ac.id/index.php/jnc/article/view/6865.

[13] Ulantari I, Kusdalinah, Eliana. Pemberian Jus Buah Naga Merah dapat Menurunkan Kolesterol Total Wanita dengan Diabetes Melitus. J Ilmu Dan Teknol Kesehat 2019;7:95–9. https://doi.org/10.32668/jitek.v7i1.229.

[14] Min Jeong et al. Effect of Change in Total Cholesterol Levels on Cardiovascular. J Am Heart Assoc 2018;7. https://doi.org/10.1161/JAHA.118.008819.

[15] Jeong SM et al. Correction: Association of change in total cholesterol level with mortality: A population-based study. PLoS One 2019;14:e0215934. https://doi.org/10.1371/journal.pone.0215934.

[16] Kanter MM, Kris-Etherton PM, Fernandez ML, Vickers KC, Katz DL. Exploring the factors that affect blood cholesterol and heart disease risk: is dietary cholesterol as bad for you as history leads us to believe? Adv Nutr 2012;3:711–7. https://doi.org/doi:10.3945/an.111.001321.

[17] Apriyanti M. Meracik Sendiri Obat & Menu Sehat Bagi Penderita Kolesterol. Yogyakarta: Pustaka Baru Press; 2016.

[18] Orkaby. The Highs and Lows of Cholesterol: A Paradox of Healthy Aging? J Am Geriatr Soc 2020;62:236–7. https://doi.org/10.1111/jgs.16302.

[19] Yi SW, Yi JJ, Ohrr H. Total cholesterol and all-cause mortality by sex and age: a prospective cohort study among 12.8 million adults. Sci Rep, 2019. https://doi.org/10.1038/s41598-018-

38461-y.

[20] Pingsen Z, Sudong L, Zhixiong Z, Jing L. Age- and sex-related difference of lipid profile in patients with ischemic stroke in China. Med 2018;97:e10930. https://doi.org/10.1097/MD.0000000000010930.

[21] Ujiani S. Hubungan Antara Usia Dan Jenis Kelamin Dengan Kadar KOlesterol Penderita Obesitas RSUD Abdul Moeloek Provinsi Lampung. J Kesehat 2015;6. https://doi.org/10.26630/jk.v6i1.24.

[22] Žitňanová I et al. Gender differences in LDL- and HDL-cholesterol subfractions in patients after the acute ischemic stroke and their association with oxidative stress markers. J Clin Biochem Nutr 2018;63:144–8. https://doi.org/10.3164/jcbn.17-105.

[23] Delisle H, Ntandou G, Sodjinou R, Couillard C, Després JP. At-risk serum cholesterol profile at both ends of the nutrition spectrum in West African adults? The Benin study. Nutrients 2013;5:1366-83. https://doi.org/10.3390/nu5041366.

[24] Malik AM, Mewo YM, Kaligis SHM. Gambaran Kadar Kolesterol Total Darah Pada Mahasiswa Angkatan 2011 Fakultas Kedokteran Universitas SAM Ratulangi Dengan Indeks Massa Tubuh 18,5-22,9 kg/m^2. J e-Biomedik 2013;1. https://doi.org/https://doi.org/10.35790/ebm.1.2.2013.3310.

[25] Harahap et al. The Effect of Red Dragon Fruit Juice Towards Cholesterol Level and Maximum Aerobic Capacity (VO2max) on Sport Science Students Treated with Heavy Physical Exercise. J Phys Conf Ser 6th Annu Int Semin Trends Sci Sci Educ 16–17 Oct 2019 2020;1462. https://iopscience.iop.org/article/10.1088/1742-6596/1462/1/012030 (accessed June 13, 2020).

[26] Kathleen M, Mayes P. Pengangkutan & penyimpanan lipid (In: Murray RK; Granner DK; Mayes PA; Rodwell VW;, Ed.). Jakarta: EGC; 2019.

[27] Pertiwi WA, Noer ER. Pengaruh Pemberian Jus Buah Naga Merah (Hylocereus polyrhizeus) Terhadap Kadar HDL Pria Dislipidemia. J Nutr Coll 2009;3:762–769. https://doi.org/https://doi.org/10.14710/jnc.v3i4.6878.

[28] Saragih B. Kolesterol dan Usaha-Usaha Penurunannya (B. Arianto, Ed.) 2011. https://www.researchgate.net/publication/319908989_KOLESTEROL_DAN_USAHA-USAHA_PENURUNANYA.

[29] Sigarlaki ED, Tjiptaningrum A. Pengaruh Pemberian Buah Naga Merah (Hylocereus polyrhizus) terhadap Kadar Kolesterol Total. Majority 2016;5:14–17. https://doi.org/http://juke.kedokteran.unila.ac.id/index.php/majority/article/view/916/730.