ISSN: 13412051
Volume 25, Issue 08, August, 2020

THE EFFICACY OF FERMENTED GLUTINOUS BLACK RICE (FGBR) SNACK TO IMPROVE LIPID PROFILE AMONG DYSLIPIDEMIA SUBJECTS: A NOVEL FINDING

Syarief, Osman[1], Fauziyah, Roro Nur[1], Suparman, Samsidi[1], Pramintarto Gurid[1], Hendriyani Heni[2]

Nutrition Departement, Health Polytechnic Ministry of Health Bandung Indonesia[1]
Nutrition Departement, Health Polytechnic Ministry of Health Semarang Indonesia[2]

ABSTRACT— Dyslipidemia in Indonesia is one of major health issues. Some examples such as figures from Central Bogor sub-district in the city of Bogor, West Java, Indonesia, showed that the proportion of lipid profile was quite large, i.e. LDL (80.3%), HDL (56.2%), total cholesterol (49%), and triglyceride (18.5%). Data retrieved from 2013 Basic Health Research also showed that dyslipidemia occurred at any age starting 15 years and older in urban and rural areas (39.5% vs. 32.1% respectively), while hypertriglyceridemia reached 13%. Fermented glutinous black rice (FGBR) has been proven to improve metabolic disorder indices, due to its rich content of antioxidant and fibres. In this study we modified FBGR into a snack bar for dyslipidemia intervention. To assess the efficacy of FGBR snack as a high antioxidant and fiber to improve lipid profile in dyslipidemia patients. A randomised control trial was conducted to assess the efficacy of FBGR snack containing high antioxidant, which is low in glucose but rich in fibre. Samples in this study were 52 adults who were dyslipidemia. Allocation into treatment groups and control group were made equal. Data was obtained from interviews, and blood tests were performed before and after intervention using independent t-test analysis. The results of the study showed that there were significant differences of efficacy in FGBR snack bar consumption to reduce the total cholesterol (p=0.003), triglyceride (p<0.001), LDL Cholesterol (p=0.002), and HDL cholesterol (p<0.001). There were significant differences of efficacy of FGBR snack bar to improve lipid profile. Therefore, FBGR snack bar has the potential to improve dyslipidemia condition.

KEYWORDS: Fermented Glutinous Black Rice (FGBR), Lipid profile, Dyslipidemia

1. INTRODUCTION

Dyslipidemia refers to unhealthy levels of one or more kinds of fat or lipid in the blood. Subjects with dyslipidemia should commonly use medication which is a statin that will help reduce low density lipoprotein (LDL) levels by interfering with cholesterol production in the liver. An interesting phenomenon observed in Central Bogor sub-district of the city of Bogor, West Java, Indonesia, showed that the proportion of lipid profile disorder was quite high, i.e. LDL (80.3%), HDL (56.2%), total cholesterol (49%), and Triglyceride (18.5%). Data retrieved from Basic Health Research (2013) also showed that dyslipidemia occurred at any age starting from 15 years onwards in urban and rural areas (39.5% vs. 32.1% respectively), while hypertriglyceridemia reached 13% (1). Fermented glutinous black rice (FGBR) has been proven to improve metabolic disorder indices because of its rich content of antioxidant and fibres. FGBR has the potential as an anthocyanin carrier which is one of the phenolic compounds. There are many types or sub species of glutinous black rice (GBR) whose content might be different from one another, as an effect of farming factors quality and various post-harvesting processes that make so many differences throughout the world. The process of making FGBR begins with washing the rice, steaming, cooling and adding yeast to ferment under anaerobic, warm environment. Only through thorough hygienic procedures would the fermentation be granted to succeed as expected. The content of the final product of FGBR would depend on the rice, the yeast, and the process. Having known that FGBR is rich of antioxidant and fibres, the provision of FGBR is then modified into a snack bar for the study subjects. The purpose of this study is to assess the efficacy of FGBR snack as a high antioxidant and fibre-based FGBR in improving lipid profile among dyslipidemia patients.

2. Method

In assessing the efficacy of FBGR snack containing high antioxidant that is low in glucose but rich in fibre, the study used a randomised control trial. Samples who participated in this study were 52 adult respondents, allocated equally into treatment group and control group, resulting to 26 respondents in each group. The samples' age was 40 years and over who suffer from dyslipidemia in West Bandung regency, West Java Province, and Tanah Datar regency of West Sumatra Province. The metabolic syndrome criteria used were obesity (abdominal obesity) i.e. increased waist circumference (>90 cm for men and>80 cm for women), and an additional of two or more criteria such as elevated blood triglyceride levels (>150 mg / dl), low HDL cholesterol (men <40 mg/dl and women <50 mg/dl), high blood pressure (≥130/≥85mm Hg), and fasting blood glucose >100 mg/dl) (International Diabetes Federation, 2005). The blood tests were performed before and after the intervention. Responden consummed one slice per day of FBGR snack bar (50 grams) for 30 days. The inclusion criteria of the study subjects are respondents who: 1) Suffer from metabolic syndrome (at least waist circumference criteria, with triglycerides and HDL not within normal limits); 2) Are at the age of 40 years and over; 3) Can recall daily eating habits; and 4) Are willing to follow the research and sign the informed consent form.The exclusion criteria of the study subjects are respondents who: 1) are women experiencing menopause; 2) suffer from coronary heart disease; 3) have a history of stroke; 4) suffer from severe diseases such as cancer, kidney failure; 5) are sportsman. Data collection was carried out through structured interviews by 7 nutritionists. This study used independent t-test analysis using SPSS for Windows version 18.00.

3. Result

Table 1 shows that the statistic test results using independent t-test and Chi Square Test at 95% confidence level indicates that: based on age, sex, education and job there was no significant difference in research subject characteristics between FBGR snack bar group and control group (p>0.05).

Table1. Characteristics of Study Subjects between Intervention and Control Group

	Average	**SD**	**n**	**%**	**Average**	**SD**	**n**	**%**	
Age	42.12	3.83			42.42	7.49			0.853*)
Sex									1.000**)
Male			0	0.0			0	0.0	
Female			26	100.0			26	100.0	
Education									0.396**)
Elementary			11	42.3			6	23.1	
Junior High			7	26.9			9	34.6	
Senior High			6	23.1			9	34.6	
Diploma			1	3.8			0	0.0	
Bachelor			1	3.8			2	7.7	
Job									0.174**)
Housewife			22	84.6			16	61.5	
Labourer			22	7.7			3	11.5	
Entrepreneur			1	3.8			3	11.5	

Guru			1	3.8			1	3.8	
PNS			0	0.0			3	11.5	
Fibre Intake	7.73	2.67			7.95	3.10			0.793*)
IMT	30.19	3.74			29.03	4.48			0.318*)

*) Independent t- test **) Chi Square test

The results of the study showed that there were significant differences of efficacy of FBGR snack bar consumption to reduce the total cholesterol (p=0.003), triglyceride (p<0.001), LDL Cholesterol (p=0.002), and HDL cholesterol (p<0.001).

Table 2. Comparison between Efficacy Provision of FBGR Snack Bar in Order to Decrease Total Cholesterol in Patients with Dyslipidemia

Variable	Intervention (n=26)		Control (n=26)		p-value*)
	Average	**SD**	**Average**	**SD**	
Total Cholesterol Pre (mg/dL)	202.96	28.27	217.00	41.62	0.161
Total Post Cholesterol (mg/dL)	190.27	27.35	211.42	44.41	0.044
Total Cholesterol Reduction (mg/dL)	12.69	8.43	5.5769	8.24	0.003

*) Independent t-test

The comparison between efficacy provision of FBGR snack bar in order to decrease total cholesterol in patients with dyslipidemia is explained in Table 2. Statistic test results using independent t-test at 95% confidence level indicate that: there was no significant difference of efficacy of FBGR snack bar against total cholesterol in patients with dyslipidemia, with p=0.161 (p>0.05); there were significant differences of efficacy of FBGR snack bar against the total final cholesterol in patients with dyslipidemia, with p value=0.044 (p≤0.05); and there was a significant difference of efficacy of FBGR snack bar based on total cholesterol decrease in patients with dyslipidemia p value=0.003 (p≤0.05).

Table 3. Comparison between Efficacy Provision of FBGR Snack Bar in Order to Decrease Triglyceride in Patients with Dyslipidemia

Variable	Intervention (n=26)		Control (n=26)		p-value*)
	Average	**SD**	**Average**	**SD**	
Triglyceride Pre (mg/dL)	128.00	3488	152.62	60.16	0.079
Triglyceride Post (mg/dL)	119.12	34.17	151.35	60.19	0.021
Triglyceride Reduction (mg/dL)	8.88	3.94	1.2692	2.29	<0.001

*) Independent t-test

The comparison between efficacy provision of FBGR snack bar in order to decrease triglyceride in patients with dyslipidemia is explained in Table 3. Statistic test results using independent t-test at 95% confidence level indicate that: there was no significant difference of efficacy of FBGR snack bar on initial triglyceride in patients with dyslipidemia, with p=0.079 (p>0.05); there was a significant difference of efficacy of FBGR snack bar to the final triglyceride in patients with dyslipidemia, with p=0.021 (p≤0.05); and there was a significant difference of efficacy of FBGR snack bar on the decrease of triglycerides in patients with dyslipidemia, with p value<0.001 (p≤0.05). The comparison between efficacy provision of FBGR snack bar to LDL decrease in dyslipidemia patients is explained in Table 4. Statistic test results using independent t-test at 95% confidence level indicate that: there is no significant difference of efficacy FBGR snack bar to LDL on patients with dyslipidemia, with p=0.172 (p>0.05); there were significant differences of efficacy of

FBGR snack bar on LDL and in patients with dyslipidemia, with p=0.031; and there were significant differences in efficacy of FBGR snack bar to LDL decrease in patients with dyslipidemia, with p value=0.002 (p≤0.05).

Table 4. Comparison between Efficacy Provision of FBGR Snack Bar to LDL Decrease in Dyslipidemia Patients

Variable	Intervention (n=26)		Control (n=26)		p-value*)
	Average	SD	Average	SD	
LDL Cholesterol Pre (mg/dL)	145.19	28.46	156.04	27.93	0.172
LDL Cholesterol Post (mg/dL)	135.92	25.89	152.69	28.38	0.031
Total LDL Reduction (mg/dL)	9.2692	7.16	3.3462	5.83	0.002

*) Independent t-test

Table 5. Comparison between Efficacy Provision of FBGR Snack Bar to HDL Decrease in Dyslipidemia Patients

Variable	Intervention (n=26)		Control (n=26)		p-value*)
	Average	SD	Average	SD	
HDL Cholesterol Pre (mg/dL)	47.81	6.74	46.00	10.37	0.460
HDL Cholesterol Post (mg/dL)	50.85	7.40	45.50	9.36	0.027
Total HDL Reduction (mg/dL)	3.03	3.52	3.0385	3.52	<0.001

*) Independent t-test

The comparison between efficacy provision of FBGR snack bar to HDL decrease in dyslipidemia patients is explained in Table 5. Statistic test results using Independent t test at 95% confidence level indicate that: there is no significant difference of efficacy of FBGR snack bar to initial HDL in patients with dyslipidemia, with p=0.460 (p>0.05); there was a significant difference of efficacy of FBGR snack bar against HDL end in Patients with dyslipidemia, with p=0.027 (p≤0.05); and there were significant differences of efficacy of FBGR snack bar on HDL decrease in Patients with dyslipidemia, with p value<0.001 (p≤0.05).

4. Discussion

The results statistically showed significant differences in the efficacy of High Antioxidant Snack Bar and Fibre-Based Tape Rice on the decrease of total cholesterol in patients with dyslipidemia, with p=0.003 (p≤0.05). There was a significant difference of efficacy of High Anti Snack Bar Snack and Fibre-Based Tape on Triglyceride decrease in Patients with dyslipidemia, with p value<0.001 (p≤0.05). There was a significant difference in the efficacy of High Anti Snack Bar Barrier and Fibre- Based Tape of Blackish Ketan to decrease LDL cholesterol in Patients with dyslipidemia, with p value=0.002 (p≤0.05). There was a significant difference in the efficacy of High Anti Snack Bar Grade and Fibre-Based Tape on HDL cholesterol decrease in Patients with dyslipidemia, with p value<0.001 (p≤0.05). There were significant differences in the efficacy of High Antioxidant Snack Bar and Fibre- Based Tape on the improvement of lipid profile in patients with dyslipidemia, with p≤0.05. A study by Tsuda T. (2008) shows that anthocyanins regulate the adipocyte function that is thought to prevent metabolic syndrome (2). Meanwhile. udy by Tsuda T. et al. (2003) also shows that the intake of corn rich in cyanidin-rich purple can prevent obesity and hyperglycemia in mice (3). Furthermore, a research by Tsuda T. et al. (2003) also shows that the administration of anthocyanin affects adiponectin secretion and adipocyte-specific gene expression in mice (4). Research results by Tsuda T. et al. (2006) also show that anthocyanins can regulate adipocytokin gene expression that affects the prevention of obesity and diabetes (5). A research by Dan Lie et al. (2015) shows that pure anthocyanin supplementation reduces dyslipidemia in diabetic patients (6). The glutinous black rice consumed by respondents in this study contains total phenol and it is one source of food containing polyphenols. Polyphenol content of each foodstuff has different bioavailability. Polyphenol composition in daily food intake was flavobols, falvones and flavanone (16%), anthocyanin (17%), catechins (20%), and biflavones (45%). It has been recorded that intake in different countries differs, as follows: The United States and Denmark (20-25 mg/day), Holland (67-69 mg/hr), and Italy (5-125 mg/day). The average intake is 35 mg/day in addition to anthocyanin and other polyphenols. In Finland, flavonoid intake is equal to or higher than that of falvonol with an average consumption of 28.3 mg hesperetin per day. Citrus fruits are practically sources of flavonoids, and are fundamentally more likely found in the fruiting regions such as southern Europe. Anthocyanin consumption was studied only in Finland. Large berries were consumed and it was found that an average consumption was 82 mg/day. Other than berries, the intake was 200 mg/day. Other polyphenol consumption in Asian country is 10-35 grams of soya per day which is equivalent to 25-40 mg of isofalvonoid intake per day with maximum intake of 100 mg/day.

Polyphenol intake varies greatly; in Germany it is around 6-987 mg/day, whereas in the Netherlands it is 23 mg/day. Based on the percentile, 10-90 ranges from 4 to 46 mg/day and some people can even be up to 100 mg/day. The main cause of intake variation is individual food preference. Consumption of one type of food source such as berry for anthocyanin and coffee for hydroxynamic acid can affect and alter total polyphenols. When an average value is required, additional favonols, falvonones, falvanols, and isofavonos intake giving daily consumption of 100-150 mg in the western population is needed. Other variables to be considered are also the intake of hydroxycinnamic acid, anthocyanin, and proantocyanidin. The total intake of polyphenols that may generally be achievable is 1 gram per day in a person who eats several servings of vegetables and fruit every day. It is very difficult to follow a diet related to total polyphenols because polyphenol intake is difficult to evaluate with a food intake questionnaire. It would be very useful if there was a biomarker to know the exposure of polyphenols. Several studies have been conducted to determine the correlation of flavonoid, flavonoid, and isoflavonid intake through plasma concentration or urinary excretion of metabolic outcomes, but these studies have not been able to demonstrate reliable measures in urine or plasma samples that can describe long-term intake and varied polyphenols (7). Consumption of glutinous black rice containing flavonoids by respondents can prevent high triglycerides, and according to a research by Octavia Z. F. et al. (2014), there is an influence of flavonoid from sweet potato leaf juice to triglyceride levels of male wistar rats fed with high fat (8). In this study, the levels of triglycerides in both groups increased after intervention. The mean elevation of triglyceride level in the control group was 12.28 mg/dL, while in the treatment group there was an increase of the mean lower blood triglyceride level of 2.15 mg/dL (8). Sweet potato leaves contain flvonoids that have antioxidant effects that can counteract free radicals that can protect the consumer from macromolecules of the cell from oxidative damage. The highest amount of flavonoids in sweet potato leaf juice is quercetin. The flavonoid content of sweet potato leaves has an atheroprotective effect that includes very powerful antioxidant effects which enhances the ability of pletelets to release nitrogen and inhibits thrombus formation. Falvonoids are associated with strong antioxidant activity. In addition, flavonoids can improve blood endothelial function, can be hypolipidemic, anti inflamatory, and can function as an antioxidant. Flavonoids can capture free radicals and prevent lipid peroxidation processes in microsomes and liposomes (9). Antioxidants can improve EDV (endothelium-dependent vasodilation). Endothelial cells have an important role in maintaining the health of blood vessels by producing nitric oxide (NO), a compound necessary to maintain the relaxation of blood vessels (vasodilatation). Arterial vasodilation caused by endothelium-dependent nitric oxide is known as endothelium-dependent vasodilation (10).

The 67 intervention studies showed that soluble fibre can significantly reduce total cholesterol and LDL cholesterol, but not significantly in crude fibre (11). Fibre fermentation can reduce the synthesis of cholesterol in the liver. In general, fibre can decrease carbohydrate absorption, decrease the glycemic index of food sources of carbohydrates, decrease insulin resistance, and improve fat concentration (17). Fibre has the properties of WHC (Water Holding Capacity) so that fibre can provide mass in the digested food to provide satiety and can reduce hunger, and ultimately reduce the amount of caloric intake (18). Fibre also slows the rate of gastric emptying by slowing the transit of nutrients during digestion, which leads to a gradual increase of glucose. This stimulates the release of insulin in small amounts (12). The relationship between the frequencies of food consumption sources of high glycemic index with metabolic syndrome is that high glycemic index carbohydrates digest faster and increase serum glucose. In contrast, low glycemic index is more slowly accepted and absorbed. This gives a gradual increase in serum glucose and does not stimulate the release of insulin in large quantities. Insulin resistance is often found in high carbohydrate intake with high glycemic index (12). The results showed that there was a correlation between the frequency of food consumption of high glycemic index with metabolic syndrome ($p=0,028$). The results of Octavia Z.F. et al. (2014) show that there is an influence of fibre from sweet potato leaf juice to triglyceride levels of male wistar rats fed with high fat. The levels of triglycerides in both groups in this study increased after intervention. The mean elevation of triglyceride level in the control group was 12.28 mg/dL, while in the treatment group there was an increase of the mean in lower blood triglyceride level of 2.15 mg/dL. The provision of sweet potato leaf juice is a fibre that has a hypolipidemic effect in mice. Fibres in sweet potato leaf juice function in controlling triglyceride levels by inhibiting the absorption of lipids in the intestine. The fibres in the small intestine can bind the fatty acids and the binding causes the lipid to come out with the fibres through the stool (8). A research by Yamashita et al. (1980) shows that a high-fibre diet can lower triglyceride levels in diabetic mice. Triglyceride levels were lower in the high-fibre diet group than in the control group. The study also showed that high-fibre diet could increase HDL in diabetic mice. HDL cholesterol and HDL cholesterol ratio with total cholesterol in mice fed a high-fibre diet was higher than in the control group. A high-fibre diet may increase HDL cholesterol, indicating that a high-fibre diet has an advantage when metabolism is not good in a diabetic state (13). A study by Bazzano L. A. (2008) shows that there is an effect of soluble fibre on LDL reduction, and it reduces the risk of coronary heart disease. Recent studies have shown that high fibre intake, especially water-soluble fibre, may reduce the risk of cardiovascular disease. Several types of soluble fibre, including β-glucan, pectin, and gum, have shown that a very well-controlled dietary intervention study can lower LDL cholesterol. Soluble fibre present in vegetables and nuts can also lower LDL cholesterol. This needs to be studied further by testing the synergistic potential between fibre intake and other phytochemicals that make cholesterol lower. Other studies with cohort design need to be done to produce a preventive effect of fibre intake on the development of coronary heart disease and other cardiovascular diseases (14).

One way that can be done in controlling lipid profile levels such as LDL levels and HDL levels is to consume foods that contain antioxidants and fibre. Eating foods containing antioxidants such as anthocyanins and fibre can lower LDL levels and increase HDL levels, resulting in a decrease in the ratio of LDL/HDL. This indicates that the smaller the LDL/HDL ratio, the lesser the risk of cardiovascular disease. This is in line with a research conducted by Qin et. Al., 2009 which states that anthocyanin consumption increases HDL concentrations (13.7% in the anthocyanin group and 2.8% in the placebo group respectively by $p \leq 0,001$) and decreases LDL concentration (13.6% in the anthocyanin group and 20.6 % in the placebo group, respectively with $p \leq 0,001$). Antosianin is the main colour component in foodstuffs that can cause the colour purple, blue, to blackish red (16). According to a study conducted by Aligitha, 2007, the anthocyanins present in black glutinous rice are cyanidine 3- glucoside type with a hydroxylated hydroxylated solution in glutinous rice. This is reinforced by a study conducted by Yanuar, 2009 which states that glutinous black rice contains anthocyanins with cyanidin- 3-glucoside and peonidin-3-glucoside components (13). Glutinous black rice is one of the fermented processed products of black glutinous rice which contains antioxidants and anthocyanins that can reduce the ratio of LDL/HDL. In tape fermentation, the microbes used are yeasts because it is used in alcoholic fermentation whose main product is ethanol. Saccharomyces cerevisiae yeast is important in the manufacture of glutinous black rice. The process produces glutinous black rice, alcohol content, and organic acids. In the process of fermentation of alcohol by yeast, starch is altered by amylase enzyme which is released into microbial maltose. Maltose can be converted into glucose by maltase enzyme. Glucose by zimase enzyme is then converted to ethanol. Alcohol is converted into organic acids through the process of oxidation of alcohol. Some of the organic acids react with the alcohol to form a tape flavor ester. Antioxidant activity on glutinous black rice is larger than black sticky rice. This is because during the fermentation process, it experiences degradation due to chemical and enzymatic reactions causing an increase in anthocyanin. This increase occurs because of the release of anthocyanins that were initially present in a bonded state. The anthocyanins present in the glutinous rice are in the form of glycosides, which are bound to sugar. Hydrolysis of glycosides by β-enzyme and D-glucosidase is the first step in anthocyanin degradation. Thus, by experiencing the degradation, anthocyanin will be separated from sugar into simpler multiply components that tend to be more stable. The simpler component is called the anthocyanidin. Plants containing anthocyanins have considerable polyphenolic antioxidants. Anthocyanins as an antioxidant in the body can prevent the occurrence of atherosclerosis and diseases of blood vessel blockage. Anthocyanins work to inhibit the process of atherogenesis by oxidizing the bad fats in the body, namely low density lipoproteins. Anthocyanins also protect the integrity of endothelial cells by lining the blood vessel walls so that no damage occurs. Endothelial cell damage is an early formation of atherosclerosis and should be avoided. In addition, anthocyanins also relax the blood vessels to prevent atherosclerosis and other cardiovascular diseases.

The mechanism of action of the anthocyanin is by inhibiting the action of 3-Hydroxy-3- methylglutaril coenzyme A reductase (HMG Co-A reductase), where this enzyme catalyses the change of HMG Co-A to mevalonic acid which is the first step of cholesterol synthesis. HMG Co-A reductase inhibitors inhibit cholesterol synthesis in the liver, causing lower plasma LDL levels. Reduced cholesterol levels will lead to changes associated with these antioxidant potentials. Cholesterol suppresses the transcription of three types of genes that regulate the synthesis of HMG Co-A synthase, HMG Co-A reductase, and LDL receptors (13). Decreasing cholesterol synthesis by HMG Co-A reductase inhibitors will remove expression barrier of the three types of genes mentioned previously, so that cholesterol synthesis activity increases. This leads to sufficient decreased cholesterol synthesis by HMG Co-A reductase inhibitors. Anthocyanins will take effect in lowering cholesterol by increasing the number of LDL receptors, so that cholesterol catabolism occurs more and more. Thus, anthocyanin can lower cholesterol and LDL. In addition, anthocyanins also have the ability to inhibit CETP (Cholesteryl ester protein transfer). By suppressing CETP activity, it can increase HDL cholesterol levels and lower LDL cholesterol levels. In addition to anthocyanin, the content that exists in glutinous black rice is fibre. The fibre is divided into two, namely: soluble fibre and insoluble fibre. The fibre contained in the tape is insoluble fibre water. Khomsan, 2002 states that insoluble fibre can be obtained from cellulose, hemicellulose, and lignin found in cereal, nuts, vegetables, and fruits. Both fibres are highly beneficial for the body because it helps in relieving bowel movements that reduce constipation and diarrhea, in removing toxins (toxins) from the colon, in reducing the risk of colon cancer because insoluble fibre helps maintain intestinal pH, and in reducing cholesterol absorption from the digestive system, which can reduce blood cholesterol and reduce the risk of heart disease (13,15). Muchtadi, 2013 states that cholesterol levels in the blood can be lowered by increasing the consumption of dietary fibre that can cause high viscosity in the gut as it can lower blood cholesterol (10). The mechanism of fibre in lowering cholesterol levels is that fibre can bind bile acids (end products of cholesterol) and fat, to be directly excreted through feces. Dietary fibre blocks the enterohepatic cycle (bile reabsorption in the intestine returns to the liver). Thus, it needs to be replaced by the manufacture of new bile acids from cholesterol supplies that can ultimately lower blood cholesterol.

5. Conclusion

In conclusion, there were significant differences in the efficacy of the FGBR snack bar to improve lipid profile. Therefore, FBGR snack bar has the potential to improve dyslipidemia condition.

6. References

[1] Ministry of Health Indonesia: Basic health research 2013. Research and development bureau 2014. Jakarta

[2] Tsuda T: Regulation of adipocyte function by anthocyanins: possibility of preventing the metabolic syndrome, J Agric Food Chem 2008: 56:642-646

[3] Tsuda T et al.: Dietary Cyanidin 3-O-y β-D-Glucoside-rich purple corn color prevents obesity and ameliorates hyperglicemia in mice. J Nutr 2003, 133: 2125-2130

[4] Tsuda t et al.: Anthocyanin enhances adipocytokine secretion and adipocyte-specific gene expression in isolated rat adipocytes. Biochem Biophys Res Commn 2004, 316:149-157

[5] Tsuda Microarray profiling of gene expression in Human adipocytes in response to anthocyanines, Biochem Pharmacol. 2006.71:1184-1197.

[6] Li D, Zhang Y, Liu Y, Sun R, Xia M: Purified anthocyanin supplementation reduces dyslipidemia, enhances antioxidant capacity and prevents insulin resistance in diabetic patients, J. Nutr. 2015, 145(4):742-8. doi: 10.3945/jn.114.205674. Epub

[7] Claudine Manach, et al: Polyphenols:food sources and bioavailability 2004 Am J Clin Nutr 2003;79:727-47. American Society for Clinical Nutrition

[8] Octavia ZF. 2014. Effect of sweet potatoes (Ipomoeabatatas (L.) Lam) juice on tryglicerides level of male mouse (Rattus norvegicus) with high fat diet. Nutrition Program Diponegoro University

[9] Peng IW et al.: Flavonoid Structure Affects the Inhibibition of Lipid Peroxidation in Caco-2 Intestinal Cells at Physiological Concentrations. J Nutr; 2003, 133; 2184-87

[10] Muchtadi D. Antioxidant and healthy tips in productive age, 2013, Alfabeta Bandung Publisher

[11] Grundy SM: Obesity, metabolic syndrome and cardiovascular disease. J Clin Endocrinol Metab (2004) 89 (6): 2595-2600. DOI: https://doi.org/10.1210/jc.2004-037

[12] Jenkins DJA, Kendall CWC, Vuksan V, Vidgen E, Parker T, Faulkner D, et al., Soluble Fiber Intake at A Dose Approved by the US Food and Drug Administration for A Claim of Health Benefits: Serum Lipidrisk Factors for Cardiovascular Disease Assesed in A Randomized Controlled Crossover Trial, Am J Clin Nutr, 2002;75(5):834-9

[13] Yamashita S and Mashita A: Effect of High-fiber Diet on Plasma High Density Lipoprotein (HDL) Cholesterol Level in Streptozotocin-induced Diabetic Rats. Endocrinol. Japan. 1980, 27 (5), 671-673

[14] Bazzano LA: Effect of soluble dietary fiber on low-density lipoprotein cholesterol and coronary heart disease risk. Curr Atheroscler Rep 2008. Dec;10(6):473-7

[15] Fauziyah, Roro Nur, Putri, Mardiyah Maulida, Surmita. 2020. Effect of Pie Based on Fermented Black Glutinous Rice and Sweet Purple Potato to Frequency of Defecation in Adolescents with Contipation. International Medical Journal. Vol 25, Issue 04. Artikel https://www.seronijihou.com/volume/IMJ/25/4/effect-of-pie-based-on-fermented-black- glutinous-rice-and-sweet-purple-potato-to-frequency-of-defecation-in-adolescents-with- constipation-5ec80c6fdc2fa.pdf

[16] Trinovani, Elvi, Afifah Riska Rafa, Fauziyah, Roro Nur. 2020. Determination of Antosianin Total Levels and Antioksidant Activities in Black Glutinous Rice Extract and Fermented Black Glutinous Extract. International Medical Journal. Vol 25, Issue 05. Artikel https://www.seronijihou.com/volume/IMJ/25/5/determination-of-antosianin-total-levels-and-antioxidant-activities-in-black-glutinous-rice-extract-and-fermented-black-glutinous-rice- extract-5ec8099a8eb18.pdf

[17] Kusmiyati, Mimin, Trinovani, Elvi, Fauziyah, Roro Nur. 2020. Activity of Mixed Ethanol Extract Selected Black Tea (Camelia sinesis L.) and Stevia (Stevia rebaudiana B.) as an Alternative Anti Diabetes Herbal Medicine. International Medical Journal. Vol 25, Issue 06. Artikel https://www.seronijihou.com/volume/IMJ/25/6/activity-of-mixed-ethanol-extract- selected-black-tea-camelia-sinensis-l-and-stevia-stevia-rebaudiana-b-as-an-alternative-anti- diabetes-herbal-medicine-5ef522fdaa75e.pdf

[18] Fauziyah, Roro Nur, Mimin AMinah, Osman Syarief, Holil M Par'I, Widi Hastuti, Surmita. 2020. Effectiveness of Steamed Brownies Base on Fermented Black Glutinous Rice on Decreased Waist Circumference in Abdominal Obesity. Jurnal Ilmu dan Teknologi Kesehatan. Vol x No x. Artikel http://ejurnal.poltekkesjakarta3.ac.id/index.php/jitek