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Effect of Unripe Berlin Banana Flour on Lipid Profile of Dyslipidemia Rats

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Abstract

Dyslipidemia is one of the risk factors of coronary heart disease and stroke. Unripe Berlin banana flour contains chemical compounds and nutrients that may affect lipid profile. This study aimed to determine the potential effects of unripe berlin banana flour on lipid profile, especially in dyslipidemia. This experiment was conducted from July to December 2018 at the Food Analysis Laboratory of State Polytechnic of Jember and the Biomedical Laboratory of the Faculty of Dentistry, University of Jember using male wistar white rats weighed 150–200 g. The rats were then divided into a negative control group consisting of normal rats (K-), a positive control group consisting of dyslipidemia rats (K+), and a treatment group consisting of dyslipidemia rats that received 0.144 g unripe berlin banana flour (UBF). Dyslipidemia condition was achieved by administering high-fat diet (HFD) for 9 weeks. Unripe banana flour was fed to the treatment group starting from the 10th weeks for 4 weeks. The measurement of pre-intervention lipid profile was performed at 9th week while the post-intervention lipid profile was measured at 13th week. Data collected were analyzed using ANOVA. Results o showed that the Berlin unripe flour (UBF) could reduce total cholesterol and LDL levels. In addition, a decrease in HDL levels in treatment group with Berlin unripe banana flour (UBF) and in the negative control group (K-). The same decrease in HDL level was also seen in the dyslipidemia group (K+). Hence, it is concluded that Berlin banana flour has the potential to improve lipid profile in dyslipidemia rats.

Key words: Dyslipidemia, lipid profile, unripe banana flour

Pengaruh Pemberian Tepung Pisang Berlin *Unripe* terhadap Perbaikan Profil Lipid Tikus Dislipidemia

Abstrak

Dislipidemia merupakan faktor risiko penyakit jantung koroner dan strok. Tepung pisang berlin *unripe* mengandung senyawa aktif dan zat gizi yang berpengaruh terhadap profil lipid. Penelitian ini bertujuan mengetahui potensi tepung pisang berlin *unripe* terhadap profil lipid pada tikus jantan galur wistar model displidemia. Penelitian dilaksanakan pada bulan Juli sampai dengan Desember 2018 di Laboratorium Analisis Pangan, Politeknik Negeri Jember dan Laboratorium Biomedik, Fakultas Kedokteran Gigi, Universitas Jember. Penelitian menggunakan tikus jantan galur Wistar dengan bobot badan 150–200 gr. Kelompok perlakuan terdiri atas kelompok tikus normal (K-), tikus dislipidemia (K+), tikus dislipidemia + tepung pisang Berlin *unripe* dosis 0,144 gram (UBF). Perlakuan dislipidemia dilakukan dengan cara pemberian *high fat diet* (HFD) selama 9 minggu. Selanjutnya, pemberian UBF diberikan dalam bentuk pakan selama 4 minggu. Pengukuran profil lipid pre-intervensi (minggu ke-9) dan *post*-intervensi (minggu ke-13). Data dianalisis dengan uji ANOVA. Hasil penelitian menunjukkan bahwa kelompok perlakuan tepung pisang Berlin *unripe* (UBF) dapat menurunkan kadar kolesterol total dan LDL. Selain itu, terjadi penurunan kadar HDL pada kelompok perlakuan tepung pisang Berlin *unripe* (UBF) dan kelompok negatif (K-). Pada kelompok K+ juga terjadi penurunan kadar HDL. Simpulan, tepung pisang Berlin memiliki potensi terhadap perbaikan profil lipid pada tikus dislipidemia.

Kata kunci: Dislipidemia, profil lipid, tepung pisang *unripe*

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Introduction

Dyslipidemia is one of the risk factors of coronary heart disease and stroke. Dyslipidemia results from an increase in Low Density Lipoprotein (LDL), triglycerides, and total cholesterol concentrations and a decrease in High Density Lipoprotein (HDL) level.[1] In 2013, 35.9% of the Indonesian population suffered from cholesterol disorders, 15.9% had a high LDL level, 11.9% had a high TG level, and 22.9% had a low HDL level.[2]

One of the ways to reduce the incidence of dyslipidemia is consuming functional food, including banana. East Java area is among the biggest producers of banana with a production of up to 1.865.772 ton in 2016.[3] *Musa acuminate* is classified as a popular and widely cultivated type of banana with berlin banana as the one that can be easily found.[4]

Consumption of 250 g of bananas per day for 4 weeks can reduce the ratio of LDL/HDL cholesterol in patients suffering from diabetes mellitus with hypercholesterolemia.[5] The high content of resistant starch (RS) in banana flour plays a significant role in maintaining glucose homeostasis, increasing satiety, and reducing hunger.[6] The maturity level of the banana affects the amount of RS.[7] Unripe berlin banana flour (UBF) has a higher amoung of RS when compared to the ripe berlin banana flour.[8]

In this study, unripe berlin bananas were processed into the flour form due to the relatively short short shelf life of this fruit. The content of RS in UBF is less than in fresh unripe berlin bananas but UBF is more palatable and can prolong the shelf life of fresh unripe bananas.[9,10] It can enhance the digestive tract function, microbial flora, blood cholesterol level, and glicemic index as well as controlling diabetes. The bioactive compound and nutrients in unripe berlin banana flour is thought to have an influence on lipid profiles. This study aimed to determine how unripe berlin banana flour affected the lipid profiles of the male wistar rat dyslipidemia models.

Methods

This study was performed on 150–200g male Wistar rats during the period of July to December 2018 at the Food Analysis Laboratory of State Polytechnic of Jember and Biomedical Laboratory of Faculty of Dentistry, University of Jember. Ethical clearance for this study was received from the Ethics Committee of the State Polytechnic of Jember (No.13049/PL17/LL/2018). The experimental rats underwent acclimatization in 33x36x12 cm plastic cages with sterile wood shaving base for one week and were fed with standard Rat Bio feed. Drinking water was provided in ad libitum.

Berlin bananas (*Musa acuminate*) from LIPI's Plant Conservation Center of the Purwodadi Botanical Garden Pasuruan, East Java, were used in this study. The UBF processing was carried out through several stages. First, the bananas were washed, peeled, cut into 1 mm size and then soaked in 0.2% citric acid solution for 10 minutes. Solution was then removed and the banana pieces were dried in a dryer until the temperature reached 60^{o}C to get a final humidity of about 8–10%. The dried bananas were then ground and sifted to produce the banana flour. This produced flour was then analyzed to determine its water, ash, fat, protein, carbohydrate, resistant starch, and flavonoids contents. A dose of 0.114 g/BW UBF was then given to the rats ad libitum.

Rats were divided into 3 groups: normal groups (K-), dyslipidemia groups (K+), and dyslipidemia a with 0.114 g unripe banana flour treatment. Dyslipidemia was achieved by giving a high-fat diet (HFD) containing 31% fat during 9 weeks. The sources of fat for this HFD formulation were margarine and beef brain. At the 10th weeks, the UBF group had UBF removed from the diet and received the HFD while the normal group received the standard feed (RatBio). The dyslipidemia group (K+) received HFD without UBF.

Lipid profiles were measured through several parameters, i.e. triglyceride, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and total cholesterol levels. The measurement of the pre-intervention lipid profile was carried out at 9th weeks and the post-intervention measurement was performed at 13th weeks. The lipid profile was gained from an analysis of blood serum collected from orbital sinus using hematocrit capillary tube. The lipid profiles were analyzed using Seimitsu LDL Cholest kit, Seimitsu HDL Cholest kit, Clona Triglyceride, and Dialine Cholesterol kit while the calculation was performed using a spectrophotometry at 546 nm.

Data collected were then analyzed using the SPSS 16 program and the Paired T-test was applied to test the differences beetween the pre-

and post-intervention profiles.

Results

The proximate analysis of unripe banana flour revealed the water, ash, fat, protein, and carbohydrate contents in the flour (Table 1). Resistant starch and an active ingredient, flavonoids, were also found in the content.

Lipid profile of the rats were analyzed before intervention and the results showed no significant difference between the K-, K +, and UBF groups (Table 2). This indicates that all groups had the same lipid levels.

For the UBF treatment group, pre- and post-test analyses were performed to assess the lipid profile. The pre-test analysis was carried out before rats with dyslipidemia were given UBF while the post-test was carried out these rats received unripe banana flour. The results presented the influence of banana flour on the lipid profile (Table 2).

UBF seemed to have the ability to significantly reduce the total cholesterol and LDL levels. In addition, a decrease in HDL level was seen in the UBF group, normal group (K-), and dyslipidemia group(K +).

Table 1 Proximate Analysis of Unripe Banana Flour

Content	Qty
Water (%)	6.53
Ash (%)	2.14
Lipid (%)	1.07
Protein (%)	4.23
Carbohydrate (%)	86.02
Resistant starch (%)	40.01
Flavonoid (mg/100g)	241

Discussion

Musa acuminate is an alternative food ingredientfor dyslipidemia treatment according to this study. The RS content in unripe bananas is higher than in the ripe ones. Since unripe banana is not considered edible and its shelf life is short, it is processed into flour to prolong its shelf life and makes it edible. This process does not reduce banana's nutritional value.[10]

It has been stated that unripe banana flour (UBF) can reduce total cholesterol and LDL levels. Findings in this study show a significant decrease in HDL level in the negative control group and UBF. However, a decrease in HDL level was also seen in the dyslipidemia group. This might be due to other factors because reduction in HDL might also be caused by inflammation and infection.[11] Hence, plasma HDL does not always reflect the CVD risk predictors due to its function as a reverse cholesterol transport (RCT) that regulates the movement of cholesterol from peripheral cells to circulated lipoproteins which eventually catabolized, excreted and removed in the liver. Therefore, to measure the atheroprotective effect of HDL, efflux capacity and antioxidant capacity measurement may be better.[12]

Banana consumption LDL/HDL ratio in people with diabetes mellitus and hypercholesterolemia, due to its flavonoid content.[5] Flavonoids have the potentials to regulatingcholesterol in the body by influencing cholesterol efflux and antioxidant capacity, leading to increased HDL level.[13,12] These flavonoids were also found in the UBF in this study. They play a role as an inhibitor in cholesterol biosynthesis by. blocking cholesterol-related enzyme activities such as 3-hydroxy-3-methylglutaril (HMG) -CoA reductase enzyme.[14] Unripe berlin banana flour is rich in phytosterol that lower cholesterol level by reducing its absorption.[15]

Another important component in UBF is RS. This study presented an RS of of 40.01% in the UBF used. The amount of RS in bananas depends

Table 2 Lipid Profile Analysis Results

Groups	Sample (Qty)	Total Cholesterol		Triglyceride		HDL		LDL	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post
K-	6	66.8±18.49	40.3±11.92	73.1±38.09	46.3±44.09	30.2±7.06	17.1±5.48*	18.4±4.84	9.6±2.36*
K+	5	68.0±10.79	45.1±14.76	118.8±59.53	67.6±33.17	26.9±6.99	17.2±5.81	14.7±6.21	8.4±2.98
UBF	7	70.0±14.27	41.1±20.45*	75.0±19.04	68.14±36.54	29.2±7.56	15.6±8.41*	17.8±4.78	7.6±4.92*

* Paired T-test, significant if $p<0.05$

on the maturity level of the fruit[7] Unripe banana flour has a higher RS percentage when compared to the ripe banana flour.[8] The high RS content of RS in banana will maintain glucose homeostasis, increase satiety, and reduce hunger.[6,16] A meta-analysis study has shown that RS can reduce total cholesterol and LDL levels when consumed for more than 4 weeks. RS can also influence lipid metabolism through its fermentation process in the colon and by changing the microbiota.[18,19] This fermentation process produces the short-chain fatty acids (SCFAs) which are easily absorbed and has the ability to inhibit cholesterol formation in the liver. RS, especially RS3, can also trigger the formation of retrograde RS andbind bile salts to its helical structure, leading to increased cholesterol utilization by suppressing primary bile acids reabsorption in the ileum and stimulating bile acid liver synthesis. Increased intestinal motility due to RS consumption can also inhibit triglycerides and cholesterol absorption from food.[17,20]

In conclusion, unripe banana flour has the potential to reduce total cholesterol in dyslipidemia. However, further research is still needed to identify the optimum RS content in UBF for increasing the serum HDL level.

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