Effect of Red Bean (*Vigna angularis* [Willd] Ohwi & Ohashi) Extract Administration on Lipid Profile, Uric Acid, and Blood Glucose Level in Male White Rat

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***Abstract*—Red bean is a source of fiber, both water-soluble or insoluble, possesses low glycemic index and beneficial for reducing cholesterol and blood glucose. It belongs to nut plants that contain about 50-150 mg of purine. This study aims to know the effect of the red bean (Vigna angularis [Willd] Ohwi & Ohashi) extract administration on lipid profile, such as on male white rat. The type of research used is laboratory experimental research using Postest With Control Group design. Red bean (*V. angularis* [Willd] Ohwi & Ohashi) was obtained in Manado, North Sulawesi. Parameters measured were total cholesterol, HDL, LDL, triglyceride, uric acid, and blood glucose level of male white rat's blood after administered red bean extract and high cholesterol-fed for 21 days. Statistical analysis used One Way ANOVA. Results showed that red bean extract administration influenced the lipid profile, could reduce LDL level, and did not increase the uric acid and glucose level. Nevertheless, further study is needed with higher dose variations of the extract and on the effect of high-cholesterol diet, based on its type and administration route.**

***Index Terms*—red beans, lipid profile, blood glucose, uric acid**

I. Introduction

Red bean (*Vigna angularis* [Willd] Ohwi &Ohashi) has become raw material for various selected tasty food, particularly for people of North Sulawesi. The usable plant part is dry seed. Red bean contains vitamin B, especially folic acid and vitamin B1, calcium, phosphorous, Fe, and protein, and becomes source of water-soluble or insoluble fiber. The water-soluble fiber is useful for decreasing cholesterol level and blood glucose.

Red bean belonging to nut plants with about 50-150 mg of purine level, if excessively consumed, will increase the uric acid level. According to Regional Health Research [1], North Sulawesi holds high number of patients with high uric acid disease, 16 % to 34%, as a result of eating patterns.

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Red bean contains fibers of 7.8g/100g, consisting of water-soluble or insoluble fiber [2]. Matsumoto and Ono [3] found that the administration of mixture of red bean, corn oil, cellulose, vitamin, and mineral, for 30 days can reduce the level of serum lipid and liver lipid of rat. Previous study showed that addition of red bean porridge at1 : 1 ratio could decrease total cholesterol level but did not increase the uric acid of the male white rat [4].

This study was intended to evaluate the effect of red bean extract administration on lipid profile in the form of total cholesterol, HDL, LDL, triglyceride, uric acid, and blood glucose level of male white rat.

II. Method

A. Experimental Design

The type of research used is laboratory experimental research using Postest With Control Group design (Fig. 1).

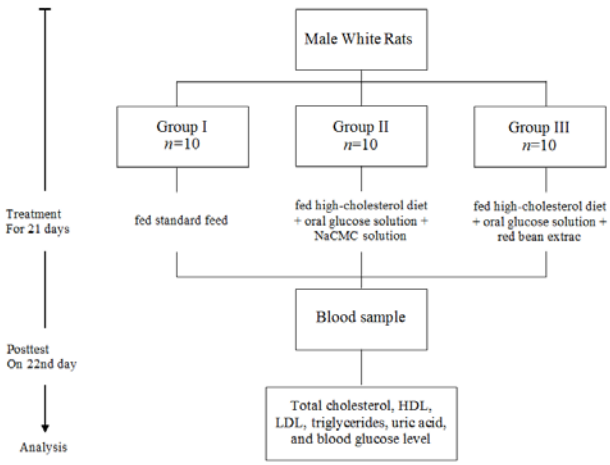

Figure 1. Diagram of the experimental design.

B. Materials

Glucose (Merck), total cholesterol, HDL, LDL, triglycerides, uric acid, blood glucose reagen kit

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(Biosystem BTS 350), AD2 standard feed, lard, coconut oil, egg yolks, distilled water, ethanol 70% (technical grade)

C. Instruments

Analytical balance (Sartorius), spectrophotometer (Shimadzu), and glassware tools were commonly used in laboratories

D. Plant Material

Red bean was obtained in Manado, North Sulawesi. The sample was identified at the Center for Plant Conservation Botanic Gardens, Indonesian Institute of Science (LIPI) Bogor

E. Extraction

The powdered of red bean (500 g) was extracted using ethanol 70% as solvent by maceration method, then filtrated. All solvent was evaporated under low pressure to obtain the semi-solid extract. The yield of red bean extract was 93.55 g (18.71%)

F. Animals

Adult male rats (150-200g; 6-8 weeks) were obtained from the Laboratory of Pharmacology, Department of Pharmacy, Manado Health Polytechnic. All animal experiments in this study have been approved by Health Research Ethics Committee Manado Health Polytechnic.

G. High-Cholesterol Diet

The high-cholesterol diets composition according to Hardiningsih and Nurhidayat [5] with minor modification as follows as: 1.5% yolk, 10% pork fat, and 1% coconut oil, added in 100 g AD-2 standard feed

H. Treatments

The rats were divided randomly into 3 treatment groups:

- Group I: normal groups were fed standard feed for 21 days.
- Group II: negative controls were fed a high-cholesterol diet, an oral glucose solution (1.35g / 200g) and 1% of NaCMC solution, for 21 days.
- Group III: treatment groups were fed a high-cholesterol diet, glucose solution (1.35g/200g orally) and red bean extract (0.252g/200g in 1% NaCMC solution orally); for 21 days.

On the 22nd day, all animals fasted for 8 hours and free access for drinking. Blood sample was collected orbital sinus veins under anesthesia condition for measurement of total cholesterol, HDL, LDL, triglycerides, uric acid, and blood glucose level.

I. Statistical Analysis

Data were analyzed by One-way analysis of variance then followed by LSD test. *P* value <0,05 was considered to be statistically significant.

III. Result

Measurements of total cholesterol, HDL, LDL, triglycerides, uric acid, and blood glucose level of the rat after administered red bean extract and high-cholesterol diet and glucose solution for 21 days, are presented in Fig. 2 (A-F).

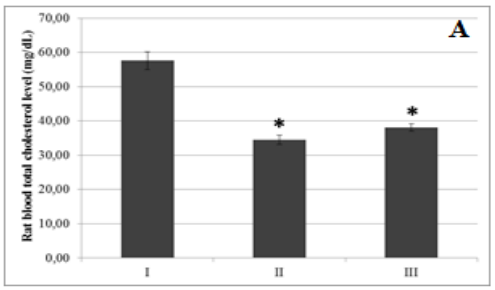

Figure 2. (A). Effect of 21 days administration of red bean extract on rats total cholesterol levels. I: normal group; II: negative controls; III: treatment groups. Values are mean ± SEM, *n*=10, * indicated significance level compare with normal group and # negative control group (p<0,05).

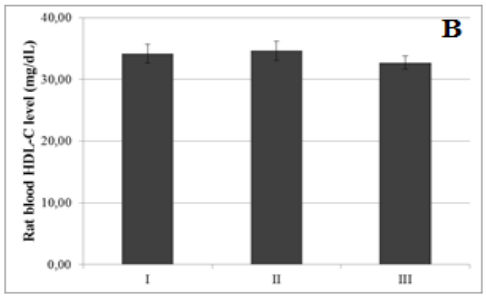

Figure 2. (B). Effect of 21 days administration of red bean extract on rats HDL-c levels. I: normal group; II: negative controls; III: treatment groups. Values are mean ± SEM, *n*=10, * indicated significance level compare with normal group and # negative control group (p<0,05).

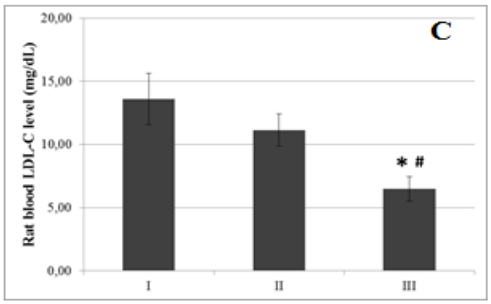

Figure 2. (C). Effect of 21 days administration of red bean extract on rats LDL-c levels. I: normal group; II: negative controls; III: treatment groups. Values are mean ± SEM, *n*=10, * indicated significance level compare with normal group and # negative control group (p<0,05).

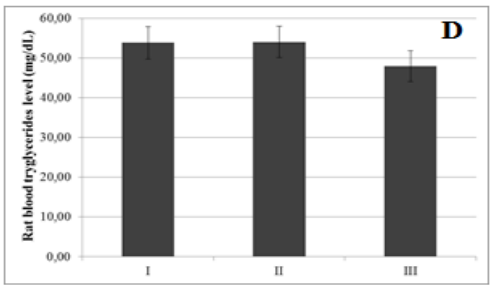

Figure 2. (D). Effect of 21 days administration of red bean extract on rats triglycerides levels. I: normal group; II: negative controls; III: treatment groups. Values are mean ± SEM, *n*=10, * indicated significance level compare with normal group and # negative control group (p<0,05).

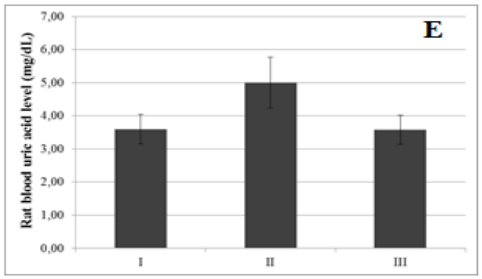

Figure 2. (E). Effect of 21 days administration of red bean extract on rats uric acid levels. I: normal group; II: negative controls; III: treatment groups. Values are mean ± SEM, *n*=10, * indicated significance level compare with normal group and # negative control group (p<0,05).

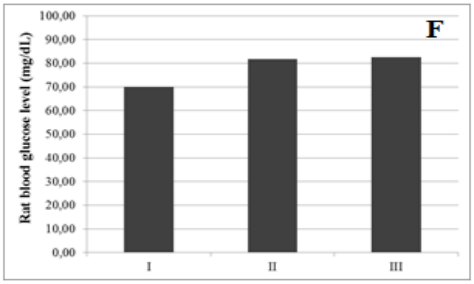

Figure 2. (F). Effect of 21 days administration of red bean extract on rats blood glucose levels. I: normal group; II: negative controls; III: treatment groups. Values are mean ± SEM, *n*=10, * indicated significance level compare with normal group and # negative control group (p<0,05).

IV. Discussion

Treatment of hyperlipidemia could be through non-pharmacological and pharmacological therapy. The principle of non-pharmacological therapy was through Therapeutic Lifestyle Changes (TLC). The TLC method must be applied to patients with hyperlipidemia before considering drug use. Components in TLC therapy include reducing intake of saturated fat and cholesterol, dietary choices to reduce LDL such as consuming plant-derived sterols, soluble fiber, reducing weight, and increased physical activity [5].

The rats, were made to be hypercholesterolemia by fed high-cholesterol diets. The high-cholesterol diets composition according to Hardiningsih and Nurhidayat [6] with minor modification as follows as: 1.5% yolk, 10% pork fat, and 1% coconut oil, added in 100 g AD-2 standard feed, given for 21 days at the same time of red bean extract administration. Muray *et al*. [7] stated that cholesterol was a typical product of animal metabolisms, such as yolk, meat, liver, and brain. Cholesterol input in high saturated fat of food such as yolk, animal's fat, and butter, can raise the plasma cholesterol level.

Red beans were contained water-soluble and insoluble fiber. Soluble fiber could reduce cholesterol levels through high viscosity (gel-like substance) in the gastrointestinal tract. High viscosity fibers would bind cholesterol and bile acids in the small intestine so they were not reabsorbed. Body compensation for decreasing bile acids was a change in cholesterol to bile acids in the liver, thereby reducing plasma cholesterol levels [8].

Non-pharmacological therapy with TLC suggests that patients with hyperlipidemia consume foods that contain plant-derived sterols [5]. Yoshida, *et al*. [9] has reported that they isolated the fatty acids and triacylglycerols from red bean extract, such as delta-tocopherol (53.7-89.3 mg/kg; gamma-tocopherol (11.2-14.8 mg/kg); phospholipid (72.2-73.4%); and triacylglycerol (20.6-21.9%). Therefore, it was suspected that red bean extract could reduce the blood lipid levels.

Red bean seeds also contain flavonoids such as of proanthocyanidin and isoflavones. Proanthocyanidins flavonoids play a role in decreased cholesterol levels by inhibiting the formation of malondialdehyde and lipase activity, while isoflavones can reduce cholesterol levels through the inhibition of apo-β hepatocyte secretion [10]. This previous research supports the assumption that red bean extract can reduce blood lipid levels. Several processed products from red bean seeds such as red bean porridge and red bean yogurt can reduce total cholesterol, LDL and triglyceride levels [4], [10]-[12].

The present study found that after 21 days of administration of red bean extract had a significant effect on LDL levels, but not on total cholesterol, HDL and triglyceride levels.

Red beans including legumes plant (Leguminosae) were rich in purines. Red beans are used by the local people of North Sulawesi as food, if consumed in excess could cause an increase in uric acid. the administration of red bean extract could not increase blood uric acid levels on hypercholesterolemia-rats.

We also found that administration of red bean extract, glucose solution and high-cholesterol diets did not increase blood glucose. Previous research was reported that the red bean extract was able to reduce blood glucose levels (antidiabetic effect) in the glucose-load rat.

V. Conclusion

Red bean extract did not statistically significantly affect the lipid profile, however it could decrease LDL level compared with the negative control group. Red bean extract did not also increase uric acid level compared with the negative control group, despite statistically non-significant. Blood glucose level was not affected by the administration of red bean extract and sugar solution.

Further study is needed using higher dose variations of red bean. Besides, the effect of high-cholesterol feed, both type and administration route, still remains to be investigated.

Acknowledgment

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References

[1] Department of Health of the Republic of Indonesia, "Basic health research of north sulawesi [in Indonesian]," Badan Penelitian dan Pengembangan Depkes R.I, Jakarta, 2008.

[2] E-Prosea, *Vigna angularis* [Willd] Ohwi & Ohashi. [Online]. Available: www.proseanet.org

[3] Y. Matsumoto and A. Ono, "Effect of dietary adzuki bean (*Phaseolus angularis*) on serum lipid concentrations in adult rats," *Kawasaki Journal of Medical Welfare*, vol. 8, no. 2, pp. 49-55, 2002.
[4] B. I. Rumagit, A. C. Wullur, and D. E. Kalonio, "The effect of red bean (*Vigna angularis* [Willd] Ohwi & Ohashi) porridge on total cholesterol and uric acid levels of white rat (*R. norvegicus*) [in Indonesian]," Riset Pembinaan Tenaga Kesehatan (Risbinakes), Politeknik Kesehatan Kemenkes Manado, 2012.
[5] J. T. Dipiro, R. L. Talbert, G. C. Yee, G. R. Matzke, B. G. Wellz, and M. L. Posey, *Pharmacotherapy A Pathophysiologic Approach*, 7th ed. USA: The McGraw-Hill Company, 2008.
[6] R. Hardiningsih and N. Nurhidayat, "Effect of hypercholesterolemia feed on the body weight of lactic acid bacteria-containing white Wistar rat [in Indonesian]," *Biodiversitas*, vol. 7, no. 2, pp. 127-130, 2006.
[7] R. K. Muray, D. K. Granner, P. A. Mayes, and V. W. Rodwell, *Biokimia Harper, (Biochemistry)*, Edisi Ke-25, Jakarta: Jakarta Penerbit Buku Kedokteran EGC, 2000.
[8] The US. Dept of Health and Human Services, *Your Guide to Lowering Your Cholesterol with TLC*, NIH Publication No. 06-5235, 2005.
[9] H. Yoshida, Y. Tomiyama, N. Yoshida, Y. Mizushina, "Profile of lipid components, fatty acid compositions and triacylglycerol molecular species of adzuki beans (*Vigna angularis*)," *J. Am Oil Chem Soc*, vol. 86, pp. 545-552, 2009.
[10] Marcelia K. dan Kartasurya M.I., "Effect of administration of red bean yogurt on total cholesterol levels in women with dyslipidemia [in Indonesian]," *Journal of Nutrition College*, vol. 4, no. 1, pp. 79-88, 2015.
[11] G. Orviyanti, "Differences in the effect of milk yogurt, red bean juice and red bean yogurt on LDL cholesterol levels and HDL cholesterol serum in dyslipidemia mice [in Indonesian]," Karya Tulis Ilmiah dalam Jurnal Media Medika Muda, Program Pendidikan Sarjana Kedokteran, Fakultas Kedokteran, Universitas Diponegoro, 2012.
[12] R. Racmandiar, "Differences in the effect of red bean juice, milk yogurt and red bean yogurt on total cholesterol levels and serum triglycerides in dyslipidemia mice [in Indonesian]," Karya Tulis Ilmiah dalam Jurnal Media Medika Muda, Program Pendidikan Sarjana Kedokteran, Fakultas Kedokteran, Universitas Diponegoro, 2012.

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