

AQUEOUS EXTRACT OF BALINESE PURPLE SWEET POTATO (*IPOMOEA BATATAS* L.) PREVENTS OXIDATIVE STRESS AND DECREASES BLOOD INTERLEUKIN-1 IN HYPERCHOLESTEROLEMIC RABBITS

¹I M. Jawi, ²A. Wiwiek Indrayani, ²I W. P. Sutirta-Yasa

¹Departement of Pharmacology, Faculty of Medicine, Udayana University, Bali-Indonesia
²Departement of Clinical Pathology, Faculty of Medicine, Udayana University, Bali-Indonesia

Background: Hypercholesterolemia can cause oxidative stress, endothelial dysfunction and atherosclerosis. Anthocyanin can prevent oxidative stress, it will decrease the inflammation by decreasing the pro-inflammatory cytokine in animal models. Purple sweet potato in Bali has been proven of having high anthocyanins content. The aim of these study was to prove the ability of aqueous extract of Balinese purple sweet potato (*Ipomoea batatas* L.) in decreasing the blood interleukin-1 level in hypercholesterolemic rabbits. **Methods:** Subjects of this study were 18 male adult rabbits divided into 3 groups with randomized post-test only control group design. Group 1 rabbits were given standard diet as a control group. Group 2 rabbits were given high cholesterol diet. Group 3 rabbits were given aqueous extract of Balinese purple sweet potato 4 ml/Kg.BW/day and high cholesterol diet. After 60 days of treatment, the blood level of total cholesterol, MDA and interleukin-1 were measured as post test examination. The data were analysed by using anova. **Results:** The results showed significant increases of blood total cholesterol, MDA, and interleukin-1 in group 2 ($p<0.05$). In group 3 the increases of blood total cholesterol and MDA levels were slightly lower than the group 2 ($p<0.05$). Group 3 also showed significantly lower of blood interleukin-1 levels than those in group 2 ($p<0.05$). **Conclusion:** From this finding, it can be concluded that aqueous extract of Balinese purple sweet potato can decrease oxidative stress and decrease the level of interleukin-1 in hypercholesterolemic rabbits.

Keywords: purple sweet potato; oxidative; stress, IL-1; rabbits

INTRODUCTION

Atherosclerosis is a vascular disorder that is the leading cause of cardiovascular diseases in the world. Atherosclerosis is a chronic inflammatory process involving the proinflammatory interleukin in vascular endothelium.^{1,2} Inflammation that occurs in endothelial usually preceded by the presence of endothelial dysfunction caused by oxidative stress. Oxidative stress will cause changes in intracellular signaling resulting in the activation of nuclear factor kappa B (NF- κ B), which will lead to increased production of inflammatory mediators such as interleukin-1, interleukin-2 and other proinflammatory interleukin.³ Plants foods that contain anthocyanins are supposed to prevent oxidative stress in order to prevent atherosclerosis, through hypolipidemic effect and antioxidant in vivo and in vitro and anti-inflammatory.^{4,6}

Address of Correspondence: I M. Jawi
Department of Clinical Pharmacology, Faculty of Medicine Udayana University, Bali-Indonesia
Email: made_jawi@yahoo.co.id

Purple sweet potato tubers from several countries have demonstrated varying levels of anthocyanin and has antioxidant properties.^{4,6} Purple sweet potato tubers in Bali have been proven to contain high anthocyanins and has been shown to be an antioxidant in animals model.⁶⁻⁸

Aqueous extract of purple sweet potato tuber is one of the simple products manufactured and has been shown to be hypolipidemic and can increase total antioxidant in hypercholesterolemic rabbits,⁸ It is expected aqueous extract of purple sweet potato tuber can reduce levels of interleukin-1, therefore, it can inhibits vascular endothelial inflammation. To prove this hypothesis the study conducted in rabbits given high-cholesterol diet for 60 days.

MATERIALS AND METHODS

The study design was a randomized post-test only control group design with 29 local Balinese male rabbits aged 4 months, were divided into 3 groups, 9 rabbit of each group. Group 1 is the negative control group (only given a standard diet).

Group 2 was given a high cholesterol diet. Group 3 is given a high cholesterol diet and aqueous extract of purple sweet potato tubers with a dose of 4 ml / kg bw/day by mixing with food, as the treatment group.

High cholesterol diet is a special diet, that consists of a mixture of rabbit food pellets brand gold blend and 1 egg yolk/day for one rabbit, for 60 days of treatment. After 60 days of treatment blood test is conducted on all rabbits. Blood is taken from a vein in the rabbit ear for examination of blood total cholesterol, MDA and the levels of interleukin-1. MDA examination conducted by the TBARS method, while the examination of the interleukin-1 by Elisa Kit. The data were analyzed by applying Oneway-Anova statistical test.

RESULTS

Blood Total Cholesterol of Rabbits

Data of blood total cholesterol were presented in Figure 1.

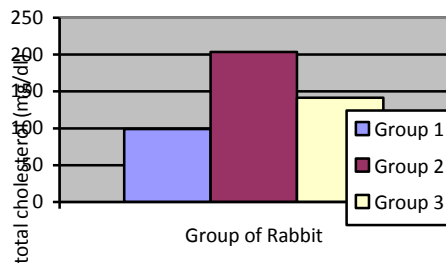


Figure 1

Average of Blood Total Cholesterol in 3 Groups of Animals

Note: Group 1 is the control group, Group 2 is the group given high-cholesterol diets and Group 3 is the group given high-cholesterol diets and water extract of purple sweet potato tubers.

Blood MDA Level

Average blood MDA level data were presented in Figure 2

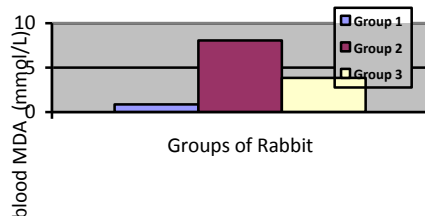


Figure 2

Average Blood MDA Level of Rabbit

Figure 2 shows group 2 (given high-cholesterol diet) an increase in blood MDA significantly ($p < 0.05$), compared to control (Group 1) and the treatment group (Group 3). In the group given

aqueous extract of purple sweet potato tuber, occurs decreased of MDA significantly ($p < 0.05$) compared with group 2. This research shows that the state of hypercholesterolemia caused increased MDA. Provision of aqueous extract of purple sweet potato tuber can prevent the increase of MDA due to hypercholesterolemia.

Interleukin-1 of the Blood

The result of interleukin-1 level in the blood of rabbits with high cholesterol diet increase significantly compared to the control group and treatment group ($p < 0.05$). The average levels of interleukin-1 in the control group were 0.064 ± 0.008 pg/ml, whereas in high cholesterol group was 0.069 ± 0.002 pg/ml. The interesting result of this study is after the high-cholesterol diet with aqueous extract of purple sweet potato tuber the titer of interleukin-1 was decreased (0.063 ± 0.002 pg/ml) significantly compared with the group with high cholesterol diet ($p < 0.05$). The comparison of results of the interleukin-1 can be seen in Figure 3.

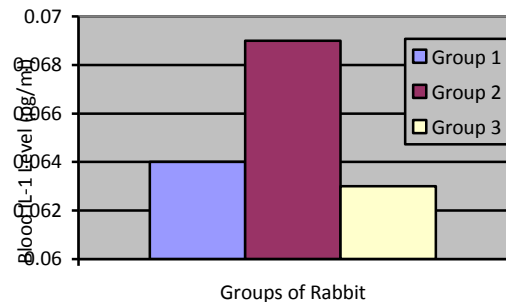


Figure 3

Comparison of blood levels of interleukin-1 of rabbit

DISCUSSION

Figure 1 shows the average of blood total cholesterol increased in the rabbits given high-cholesterol diet for 60 days. The increase was highly significant ($p < 0.05$), compared with group 1 and group 3. The average of total cholesterol in group 1 (control) was 100.200 ± 2.00 , group 2 was 215.400 ± 8.49 , and group 3 was 144.133 ± 4.34 .

In this study, high-cholesterol feeding for 60 days led to an increase in total cholesterol, MDA and interleukin-1 levels were significantly ($p < 0.05$). Hypercholesterolemia is happening will cause an increase in ROS through activation of NADPH oxidase enzyme,⁹ resulting in an increase in MDA.^{10,11} Feeding high cholesterol along with aqueous extract of purple sweet potato tuber caused a decrease in total cholesterol, MDA and interleukin-1 were significantly ($p < 0.05$).

Relatively high anthocyanin aqueous extract of purple sweet potato tuber,⁷ can prevent oxidative stress, both directly and indirectly.¹² Additionally

anthocyanin can improve lipid profiles,^{13,14} through inhibition of cholesterol absorption in the gastrointestinal tract, decreased production of lipoproteins in the liver and modulates LDL receptors.¹⁴

The results in this study are consistent with several studies examining the benefits of anthocyanins from various plants, in the vital organs such as; to reduce oxidative stress in the liver tissue,¹⁵ and vascular endothelial.¹⁶ Research on tissue culture incubated with high anthocyanin from extracts of black rice, there was a significant reduction in oxidative stress by reducing the formation of superoxide.¹⁰

The reduced of blood total cholesterol levels due to the aqueous extract of purple sweet potato tuber will prevent the oxidative stress resulting in decreased blood MDA. As a result of the reduction in oxidative stress would improve endothelial function, preventing inflammation in the endothelium resulting in decreased interleukin-1. Interleukin-1 is a proinflammatory cytokine that can increase the expression of various inflammatory mediators through the activation of NF-kB.¹⁷ Anthocyanins and other flavonoids may prevent the activation of NF-kB and therefore reduces the production of various proinflammatory cytokine.^{18,19}

CONCLUSION

From these results it can be concluded that, aqueous extract of purple sweet potato tuber has an ability to prevent oxidative stress in the blood and decrease the interleukin-1 by decreasing total cholesterol in rabbits fed with high cholesterol diet.

ACKNOWLEDGEMENTS

The authors would like to thank to Research & Development Unit of Faculty of Medicine Udayana University, Bali-Indonesia for financially supported of this research.

REFERENCES

1. Arenillas, J.F., Alvarez-Sabin, J., Molina, C. A. 2008. Progression of Symptomatic Intracranial Large Artery Atherosclerosis is Associated with a Proinflammatory State and Impaired Fibrinolysis. *Stroke*, 39:1456.
2. Phipps, R. P. 2000. Atherosclerosis: The Emerging Role of Inflammation and CD 40-CD 40 Ligand System. *Proc Natl Acad Sci U S A*. 97: 6930-6932.
3. Han K H, Matsumoto A, Shimada K, Sekikawa M, Fukushima M.2007. Effects of anthocyanin-rich purple potato flakes on antioxidant status in F344 rats fed a cholesterol-rich diet. *Br J Nutr*. 98(5):914-21.
4. Kano M, Takayanagi T, Harada K, Makino K, and Ishikawa F. 2005. Antioxidative Activity of

- Anthocyanins from Purple Sweet Potato, *Ipomoea batatas* Cultivar Ayamurasaki. *Biosci Biotechnol. Biochem*.69(5):979-88.
5. Lachman J, Hamouz K, Sulc M, Orsak M, Pivec V, Hejtmankova A, Dvorak P. 2009. Cultivar differences of total anthocyanins and anthocyanidins in red and purple-fleshed potatoes and their relation to antioxidant activity. *Food Chemistry*. 2009. 144:836-43.
 6. Jawi, I M, Suprpta D N, Dwi S U, Wiwiek I.2008. Ubi Jalar Ungu Menurunkan Kadar MDA dalam Darah dan Hati Mencit setelah Aktivitas Fisik Maksimal. *Jurnal Veteriner Jurnal Kedokteran Hewan Indonesia*. 9(2):65-72.
 7. Suprpta D N, Antara M, Arya N, Sudana M, Danuaji A S, Sudarma M. 2004. Kajian Aspek Pembibitan, Budidaya dan Pemanfaatan umbi-umbian sebagai sumber pangan alternatif. Laporan Hasil Penelitian. Kerjasama BAPEDA Propinsi Bali dengan Fakultas Pertanian UNUD.
 8. Jawi I M dan Budiasa K. 2011. Ekstrak Air Umbi Ubijalar Ungu Menurunkan Total Kolesterol Serta Meningkatkan Total Antioksidan pada Darah Kelinci. *Jurnal Veteriner, Jurnal Kedokteran Hewan Indonesia*. 12 (2); 120-5.
 9. Madamanchi N R, Vendrov A, Runge MS. 2004. Oxidative Stress and Vascular Disease. *Arterioscler Throm Vasc Biol*. 25(1): 29-38.
 10. An-Na C, Hua-Lin W, Hung-I Y, Chi-Shuen C, Hui-Chiao L, and Wei-Chin L. 2006. Antioxidant Effect of Black Rice Extract through the Induction of Superoxide Dismutase and Catalase Activities. *Lipid*. 41(8):797-803.
 11. Chen W P, Mao T J, Fan L, Zhou Y H, Yu J, Jin Y, Hou P C. 2011. Effect of purple sweet potato on lipid metabolism and oxidative stress in hyperlipidemic rats. *Chinese*. 40(4):360-4.
 12. Padda M S. 2006. "Phenolic Composition and Antioxidant Activity of Sweetpotatoes (*Ipomoea batatas*, L)". (A Dissertation). Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirement for the degree of Doctor of Philosophy in The Department of Horticulture.
 13. Murkopic M. 2004. Effects of Elderberry Juice on Fasting and Postprandial Serum Lipids and Low-Density Lipoprotein Oxidation in Healthy Volunteers: a Randomized, Doubled-Blind, Placebo-Controlled Study. *European Journal of Clinical Nutrition*. 58(2):244-9.
 14. Valcheva-Kuzmanova S, Kuzmanov K, Tancheva S, Belcheva A.2007. Hypoglycemic effect of Aronia *Melanocarpa* Fruit Juice in Streptozotocin-Induced Diabetic Rats. *Methods Find Exp Clin Pharmacol*. 29(2):101.

15. Guzik T J, Olszanecki R, Sadowski J, Kapelak B, Rudzinski P, Jopek A, Kawczynska A, Ryszawa N, Loster J, Jawien J, Czesnikiewicz-Guzik M, Channon K M, Korbust R. 2005. Superoxide Dismutase Activity and Expression in Human Venous and Arterial Bypass Graft Vessels. *Journal of Physiology and Pharmacology*. 56(2): 313-323.
16. Speciale A, Canali R, Chirafisi J, Saija A, Virgili F, and Cimino F. 2010. Cyanidin-3-O-glucoside Protection against TNF- α -Induced Endothelial Dysfunction: Involvement of Nuclear Factor- κ B Signaling. *J. Agric. Food Chem.* 58 (22):12048–54.
17. Curti M L R, Jacob P, Borges M C, Rogero M M, and Ferreira S R G. 2011. Studies of Gene Variants Related to Inflammation, Oxidative Stress, Dyslipidemia, and Obesity: Implications for a Nutrigenetic Approach. *Journal of Obesity*, Volume 2011 (2011), Article ID 497401, 31 pages
18. Ahmed S, Wang N, Hafeez B B, Cheruvu V K, and Haqqi T M. 2005. Punica granatum L. Extract Inhibits IL-1 β -Induced Expression of Matrix Metalloproteinases by Inhibiting the Activation of MAP Kinases and NF- κ B in Human Chondrocytes In Vitro. *J Nutr.* 135(9): 2096–2102.
19. Rasheed Z, Akhtar N, Anbazhagan A N, Ramamurthy S, Shukla M, and Haqqi T M. 2009. Polyphenol-rich pomegranate fruit extract (POMx) suppresses PMACI-induced expression of pro-inflammatory cytokines by inhibiting the activation of MAP Kinases and NF- κ B in human KU812 cells. *Journal of Inflammation*.6(1):9255-61.



This work is licensed under
a Creative Commons Attribution