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Purple sweet potato ethanolic extract reduces aortic VCAM expression in rabbit with high-cholesterol diet

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ABSTRACT

Background: Coronary heart disease is often caused by atherosclerosis. This disease is one of the most common causes of death in the world, especially in developing countries. Atherosclerosis is caused by an increase of proinflammatory cytokines such as IL-1, IL-6, IL-8, monocyte chemoattractant protein, VCAM and ICAM and various enzymes such as COX-2 and matrix metalloproteinase. The aim of this study was to investigate the effect of anthocyanin-containing Balinese purple sweet potato ethanolic extract (PSPEE) on aortic VAM expression in high-cholesterol diet-fed rabbits.

Methods: This study was an experimental laboratory study with randomized control group design post-test only design using 16 local Balinese rabbits aged 4-5 months obtained from The Laboratory of Pharmacology and Therapy, Faculty of Medicine, Udayana University.

Results: It was found that the mean VCAM expression in the first (control) group was higher than that of the second (treatment) group (63.3750 versus 6.1250, respectively). Thus, there was a significant decrease in aortic VCAM expression due to the administration of PSPEE ($p < 0.05$).

Conclusion: It can be concluded that the anthocyanin-containing ethanolic extract of purple sweet potato tubers inhibits atherosclerosis via the inhibition of aortic VCAM expression.

Keywords: Purple sweet potato, VCAM, aorta, rabbit
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INTRODUCTION

Coronary heart disease is closely related to oxidative stress and hypercholesterolemia. Increased cholesterol, especially LDL (low-density lipoproteins) and triglycerides in the blood accompanied by oxidative stress that will trigger the oxidation of LDL. Oxidized LDL is essential to the development of atherosclerosis and inflammation. Atherosclerosis is one of the leading causes of death, especially in developing countries.[1] This disease is associated with the elevated expression of proinflammatory cytokines such as IL-1, IL-6, IL-8, monocyte chemoattractant protein, VCAM, and ICAM, as well as various enzymes such as COX-2 and matrix metalloproteinase. Anthocyanins may decrease adhesion molecule levels such as ICAM-1 and VCAM-1, which play a role in the inflammatory and atherosclerotic processes. The effect appears to be mediated by its antioxidative and anti-inflammatory mechanisms.[2] Intake of anthocyanin or flavonoids in healthy people can reduce levels of proinflammatory mediators by inhibiting NFkB function.[3] Balinese purple sweet potato tubers are known to have high anthocyanin content,[4] and are efficacious as a source of antioxidants in mice with oxidative stress.[5] This study addressed the hypothesis that purple sweet potato ethanolic extract (PSPEE) containing 0.07% anthocyanin may prevent atherosclerosis through the inhibition of aortic VCAM expression.

RESEARCH METHODS

This research was an experimental laboratory study with the randomized control group posttest only design. This study used 4-5 months old local Balinese rabbits obtained from Animal Laboratory Unit (now known as The Division of Drug Development and Laboratory Animal, Integrated Biomedical Laboratory Unit), Faculty of Medicine, Udayana University. Histopathological examinations were done in Laboratory of Pathological Anatomy, Faculty of Medicine, Udayana University. Federer's formula [(t-1) (n-1) ≥ 15] was used to find the minimum number of replicates (replication). Since the number of treatments (t) was 2, it can be calculated that the number of replicates (replication [n]) was 8. Thus, 16 rabbits were used in this study. In accordance with the research design, the sample is divided into two groups, namely group 1 (rabbits with a high-cholesterol diet without PSPEE) and group II (rabbits with a high-cholesterol diet with 200 gr of PSPEE/rabbit/day). The rabbits were adapted for two weeks and treated for 90 days. After being treated with high-cholesterol diet ($_{+}$ PSPEE), all animals were euthanized, and their aortae were isolated for histopathological examination.

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Table 1 VCAM expression in aortic endothelia of hypercholesterolemic rabbits

Group (n)	Mean	Std. Deviation	p
Control (8)	63.3750	57.26115	0.026
Treatment (8)	6.1250	11.41975	

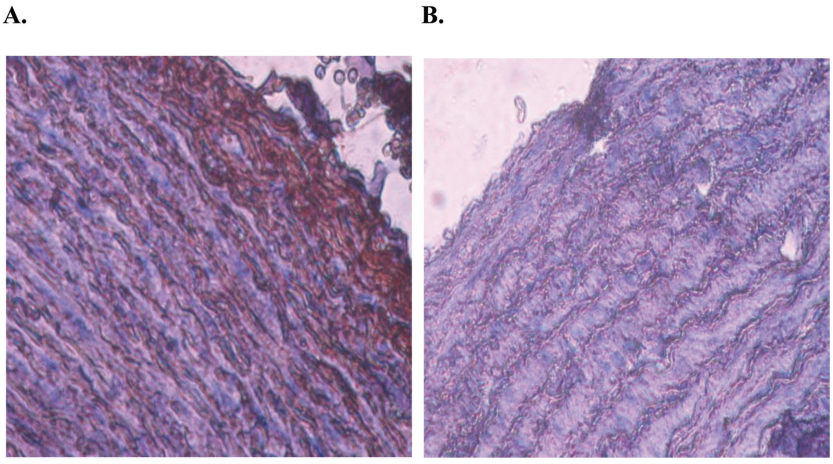

Figure 1 The expression of VCAM in aortae of hypercholesterolemic rabbits. (A) PSPEE-treated group. (B) Control group

RESULTS

It is found that the average aortic VCAM expression in the first (control) group is higher than in the second (treatment) group. Statistical analysis shows a significant difference in VCAM expression between both groups ($p < 0.05$), as seen in Table 1.

Histopathological sections of aortae are also presented (Figure 1). The histomorphological integrity of the luminal aspect of aortae between groups is relatively similar.

DISCUSSION

The administration of PSPEE can decrease VCAM-1 expression in the aortic endothelium of this model of hypercholesterolemia. This decrease will lead to reduced inflammatory process in the endothelium. This occurs because the flavonoids contained in the PSPEE may act as anti-inflammatory agents. The flavonoids-induced anti-inflammatory effect can occur through several mechanisms: inhibiting enzymes that play a role in inflammatory processes such as COX2 and iNOS,[6,7] and enzymes that play a role in arachidonic acid metabolism such as PLA-2, lipoxygenase.[8] Another possible mechanism is inhibition of gene expression involved in the inflammatory process[6,8] and through the antioxidative effects.[6]

The decrease in VCAM expression in this study was probably caused by active substances or flavonoids contained in purple sweet potato tubers. Balinese purple sweet potato tubers present are high in anthocyanin,[4] and are efficacious as antioxidant sources in mice with oxidative stress.[5] A purple sweet potato tuber containing 0.07% anthocyanin may inhibit atherosclerosis through inhibition of proinflammatory IL production. Anthocyanin may decrease adhesion molecule levels such as ICAM-1 and VCAM-1, which play a role in the inflammatory process. An antioxidant is effective in preventing the occurrence of atherosclerotic disease due to its anti-inflammatory effect, but the exact mechanism is currently unknown.[9] Intake of anthocyanin/flavonoids in relatively healthy people can reduce levels of proinflammatory mediators by inhibiting the function NF-kB.[3] Epidemiological data, clinical studies, and animal studies reported that anthocyanins/antioxidants present in fruits and vegetables could reduce atherosclerosis. Purple sweet potato tubers are known to exert antioxidative properties although the efficacy is lower than vitamin E. Anthocyanins/flavonoids are found in purple sweet potato. The Research Team of the Faculty of Agriculture, Udayana University, showed that the anthocyanin content of purple sweet potato is varied between 110mg/100 gram to 210 mg/100 grams of fresh tubers.[4] The anthocyanins found in purple sweet potato can suppress atherosclerosis, oxidative stress, and VCAM expression by altering cholesterol levels and lipid levels in mice.[10] Provision of anthocyanin-rich extract supplement from purple sweet potato has anti-atherogenic effect by regulating cholesterol metabolism.[11]

CONCLUSION

From the result and discussion, it can be concluded that the administration of purple sweet potato ethanolic extract (PSPEE) can decrease aortic endothelium VCAM expression in rabbits with a high-cholesterol diet.

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