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Comparison of Antihypertensive and Antioxidative Effect of Mahogany (*Swietenia mahagoni* (L.) Jacq.) Seed Extract and Purple Sweet Potato (*Ipomoea batatas*) Tuber Extract on Rodent Model of Hypertension

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ABSTRACT

Most herbal remedy uses in the society are not supported by sound scientific evidences. The purpose of this study was to demonstrate antihypertensive and antioxidative effect of mahogany (*Swietenia mahagoni* (L.) Jacq.) seeds extract compared to purple sweet potato tuber aqueous extract in hypertensive rats. This study used pre-test and post-test control groups design. Fourty two rats were allocated into 7 groups. The control group was given NaCl for 4 weeks on a daily basis. Treatment groups were given NaCl and also aqueous extracts of mahogany seed with the dose of 100 mg and 200 mg, mahogany seed ethanolic extracts with the dose of 100 mg and 200 mg, and aqueous extracts of purple sweet potato tuber with the dose of 100 mg and 200 mg for 4 weeks. Before the commencement of treatments, systolic blood pressure (SBP) and blood MDA level were examined. Measurements of SBP were also done every 3 days during the treatment period. After 4 weeks of treatment, SOD and MDA level in blood were examined.There are significant decreases in SBP and blood MDA, and significant increases in SOD levels ($p< 0.05$) in all treatment groups.

Keywords: Mahogany seed, purple sweet potato, antihypertension, antioxidant**.**

INTRODUCTION

Epidemiological studies prove that foods with high content of flavonoids can lower blood pressure through antioxidative effects. Provision of aqueous extract of purple sweet potato tubers containing high flavonoids lower blood pressure and oxidative stress[1,2].

Mahogany fruit seeds contain flavonoids and has been proven as an antioxidant in vitro and inhibits angiotensin-converting enzyme (ACE)[3]. Mahogany fruit seeds have been used empirically in the community as an antihypertensive[4,5], as well as natural antioxidants[6], with mild side effects and toxic effects[7].

Before conducting clinical trials to prove the effects of mahogany seed extract as antihypertensive agent and antioxidant, it should be investigated in hypertensive model of rats, whether the ethanol extract or aqueous extract of mahogany fruit seeds can lower blood pressure and reduce oxidative stress. We also compare these effects with those of aqueous extract of purple sweet potato tubers that had been studied in a rodent model of hypertension.

METHODS

The subject in this study were 42 male Wistar rats aged 3-4 months (175-225 g), obtained from the Laboratory of Food and Nutrition, Gajah Mada University, Yogyakarta. Hypertensive rats is a group of rats that were administered NaCl at a dose of 2% of body weight every day, as a control. The treatment group was treated rats with NaCl 2% of body weight each day and given the test material with a certain dose. The duration of treatment was 4 weeks. There were 6 treatment groups, namely: aqueous extract of mahogany seeds 200 mg/day and 100 mg/day, the ethanolic extract of mahogany seeds with a dose of 200 mg/day and 100 mg/day and the aqueous extract of purple sweet potato tuber with the dose of 200 mg/day and 100 mg/day. The use of animals in this study was approved by Ethics Committee of The Faculty of Medicine, Udayana University, Bali.

MATERIALS

The ethanolic extract of mahogany seeds was made according the following procedure: a total of 300 grams of powdered seeds mahogany was macerated using 500 ml of 95% ethanol for 1 day. The macerate was then filtered. The waste was re-macerated twice and allowed to stand overnight. The solvent was evaporated with a rotary vacuum evaporator at a temperature of 50^{0}C, followed by heating in oven at a temperature of 40^{0}C to obtain dry extract. Dry extract was dissolved into the water at a dose of 100 mg and 200 mg/rat/day.

Aqueous extract of mahogany seed powder was made according the following procedure: A total of 300 grams of powdered mahogany seeds was macerated using 500 ml of distilled water for 1 day. The macerate was then filtered. The waste was re-macerated twice. The solvent was evaporated using a hair dryer, followed by heating in oven at temperature of 40^{0}C to obtain dry extract. Dry extract was used as the test material by dissolving it into the water with a dose of 100 mg and 200 mg/rat/day.

Aqueous extract of purple sweet potato tubers was made according the following steps: Purple sweet potato tubers obtained from the farmers were washed with clean water and then peeled. Once peeled, sweet potato tubers were cut crosswise with a thickness of 2.0-2.5 cm. Sweet potato chunks were made into juice by mixing them with water at a ratio of 1 kg of sweet potato plus 1 liter of water. The juice was filtered with three layers of gauze. Fluid obtained from the filtration was heated to boiling. The material is dried to obtain a dry extract. Dry extract was used as the test material by dissolving into it the water with a dose of 100 mg and 200 mg/rat/day.

Measurement of Systolic Blood Pressure

Systolic blood pressure (SBP) was measured with a tail-cuff plethysmography sphygmomanometer (S-2 Ser.N09208, Hugo Sachs Electronic, Germany). Before the study, the rats were adapted for 2 weeks. After 2 weeks of adaptation, we performed blood pressure measurements as a

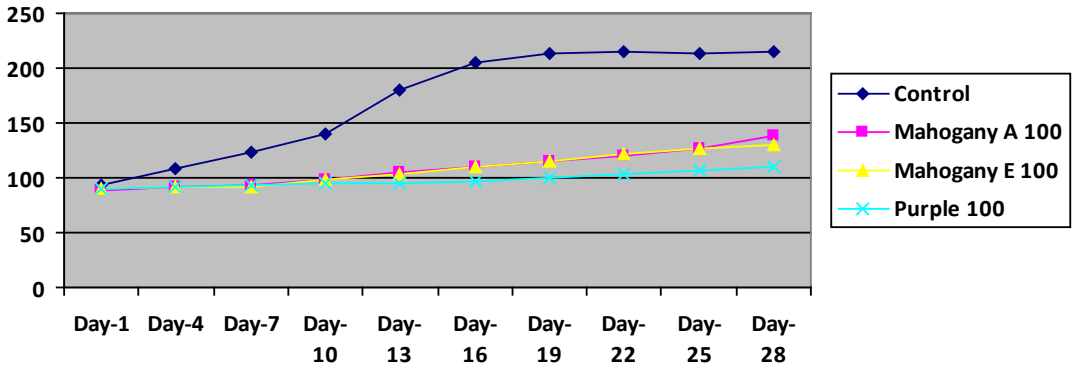

Fig. 1: SBP during 28 days of observation in groups provided wit aqueous or ethanolic extract of mahogany seed extract or aqueous extract of purple sweet potato with the dose of 100 mg

pre-test data. During treatment, SBP was checked every 3 days.

Blood examination

After 4 weeks of treatment, the blood samples were taken from retro-orbital plexus. The blood samples were used for the quantification of MDA and SOD level. MDA examinations (pre and post test) were conducted using the thiobarbituric acid-reactive substances (TBARS), meanwhile SOD level was quantified using Randox total antioxidant kit method.

RESULT

The results of SBP and MDA level before the study (pre-test) do not show any difference for all rats ($p > 0.05$). The average SBP is between 88.83 ± 3.81 to 93.33 ± 5.24 mmHg, in all groups. The statistical test of this average does not differ ($p >$

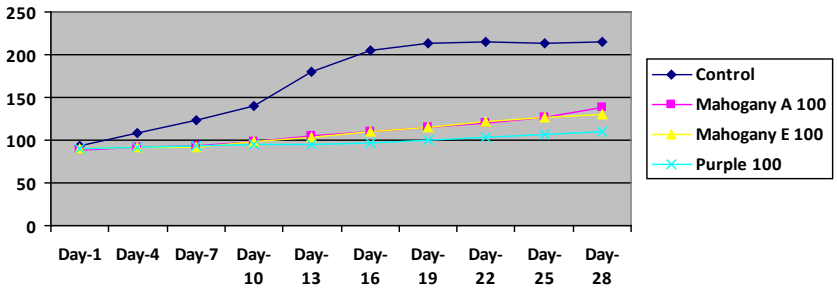

Fig. 2 : SBP during 28 days of observation in groups provided with aqueous or ethanolic extract of mahogany seed extract or aqueous extract of purple sweet potato with the dose of 200 mg

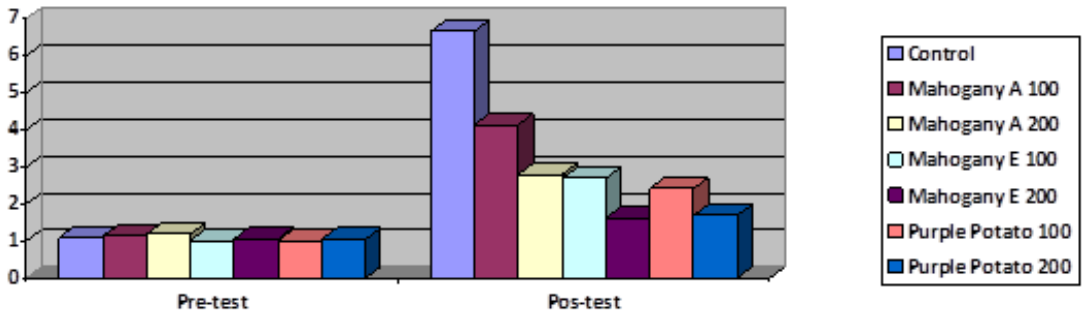

Fig. 3 : Pre and post-test blood Levels of MDA in all group of rats

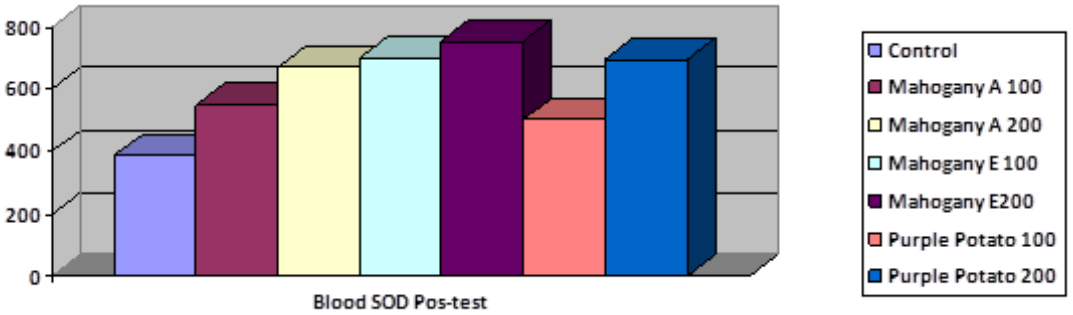

Fig. 4: Blood SOD Levels After Treatment For 28 days All Group of Rats

0.05). The average blood MDA levels are between 1.00 ± 0.11 to 1.13 ± 0.16 mmmol / l, in all groups. Statistical tests performed on average figures were not different (p> 0.05). Thus, at the beginning of the study, all rats used in this study were homogeneous. After being given daily NaCl administration for 4 weeks, the first group (the untreated hypertensive rats) shows a significant increase in SBP (p <0.05). Daily administration of aqueous extract of mahogany seeds, ethanolic extract of mahogany seeds (100 mg) and aqueous extract of purple sweet potato tuber (100 mg) prevent the increase in SBP until the 10th day. SBP increases in both groups is observed in the 13th day, with a value much lower than that of the untreated group (Fig 1). The administration of 200 mg of each extracts exhibits similar results with those given 100 mg of extract (Fig 2).

MDA levels at baseline are similar in all groups (Fig 3). After 4 weeks of treatment, the MDA levels rise significantly. These increases can be attenuated by the administration of ethanolic extract of mahogany seeds (at the dose of 200mg) (p <0.05).

Blood SOD level in the control group (untreated hypertensive rats) is the lowest. In all treatment groups, there are significant increase of SOD levels (p <0.05). We find that the ethanolic extract of mahogany fruit seeds is the most potent inducer of SOD (Fig 4).

DISCUSSION

We find that mahogany seed extract can prevent the increase of blood pressure in rats given high doses of NaCl. In this study, we also prove that aqueous extract and ethanolic extract of mahogany seeds can prevent oxidative stress. The ethanol extract of mahogany seeds is more potent in preventing oxidative stress and preventing increase of SBP. However, when compared with the aqueous extract of purple sweet potato tuber, the ethanolic extract of mahogany seeds have similar potential in preventing the increase of SBP.

Mahogany seed extract has been known to contain alkaloids, flavonoids, saponins, tannins and terpenoid[3,7], has antioxidative properties in vitro by neutralizing free radicals and inhibiting xanthine oxidase, an enzyme that can increase the superoxide ion[7]. Mahogany seed extract contains antioxidants that can lower blood pressure. This effect can be established the levels of NO. Therefore, this extract is potential to be developed as vasodilator. Antihypertensive efficacy of mahogany seed extract is associated with its antioxidative properties and its ability to inhibit angiotensin-converting enzyme (ACE)[3]. We found that mahogany seeds extract exert antioxidative effect by increasing SOD and decreasing MDA level in this NaCl-induced rodent model of hypertension. Further study using the same model should be done to confirm the inhibitory effect of mahogany seeds extract on ACE activity.

We find that the effects of aqueous extract of purple sweet potato tubers are consistent with our previous studies[1,2]. Our study further confirms the positive association between flavonoids- or anthocyanin-rich food and prevention of hypertension occurence. One study shows that eating foods rich in flavonoids/anthocyanins for 14 years can prevent the occurrence of hypertension to 8%, in male and female subjects[8]. Other study also prove that flavonoids can lower SBP and DBP to as much as 5.88 mmHg and 3, 50 mmHg, respectively[9]. The results of our study is also concordant with another study that examine the effect of red wine polyphenolic compounds (RWPCs). The RWPCs has been shown to induce vasodilation by increasing NO level, as a result of increased eNOS activity. RWPCs also increase the release of prostacyclin and inhibits the synthesis and decreases the effect of endothelin-1[10].

Various types of plants-derived anthocyanins have been shown to lower blood pressure by a variety of mechanisms. Cyanidin-3-glucoside, a typical anthocyanin pigment, increases eNOS expression in arterial endothelial cells in vitro[11]. Purple corn anthocyanins can significantly lower blood pressure and pulse rate compared to controls in animals model[12]. The hypotensive effects of anthocyanins, or foods with high anthocyanin content is mediated by its antioxidative properties, because ROS plays an important role in causing endothelial dysfunction. Anthocyanins from chokeberry, bilberry and elderberry has been shown to maintain endothelial function properly after being exposed to the ROS in vitro[13]. Oxidative stress can reduce the bioavailability of NO and attenuate the ability of

blood vessels to dilate properly. Giving antioxidants, particularly anthocyanins, is particularly useful in treating this condition[14]. Based on the results of our study and those of other relevant studies, we propose that mahogany seed and purple sweet potato tubers, and their combination, is promising to be developed as a new source of drug to prevent or treat hypertension.

CONCLUSIONS

The ethanolic and aqueous extract of mahogany seeds can lower SBP in NaCl-induced rodent model of hypertension. Their effect is found to be comparable with that of purple sweet potato tubers extract. The mahogany seed ethanolic extract is more potent in increasing SOD, and lowering both MDA level and SBP than aqueous extract of purple sweet potato tubers.

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