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Research Article

Anti-hypertensive activity of Alang – Alang (*Imperata cylindrica* (L.) Beauv. root methanolic extract on male Wistar rat

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ABSTRACT

Alang – alang (*Imperata cylindrica*) root was used an anti hypertension traditional medicine in Southeast Sulawesi. Study of antihypertensive activity of Alang – alang (*Imperata cylindrica*) root methanolic extract on NaCl induced hypertensive rat have been done by non invasive method. Non invasive method used two parameters, heart rate and amplitude stroke heart volume, those have direct correlation with blood pressure. Hypertensive rats were induced with NaCl orally twice a day for 14 days. Therapy with extract and reference drugs (amlodipine and captopril), were given orally to hypertensive rats for 14 days once a day. During therapy NaCl was given. Heart rate and amplitude were measured before therapy (D_{14-0}) and 4 hours after the first therapy (D_{14-4}), and then day 1 (D_{15}), day 3 (D_{17}), day 6 (D_{20}), day 10 (D_{24}), and day 14 (D_{28}). Three doses of the extract were tested, 60, 90 and 115 mg/kg-bw. The results showed that reference drugs (amlodipine and captopril) and *Imperata cylindrica* root methanolic extract at doses of 60 and 90 mg/kg-bw, have an anti-hypertensive effect by decrease both two parameters, and at a dose of 115 mg/kg-bw did not significant anti hypertensive effect. In conclusion two of doses tested of the extract (60 and 90 mg/kg-bw) gave anti-hypertensive effect and the dose of 90 mg/kg-bw had the highest effect.

Keywords: Alang-alang; Dana; *Imperata cylindrica;* hypertensive; heart rate; amplitude stroke; heart volume

INTRODUCTION

Cardiovascular disorders as hypertension is a disease which has high population people. Hypertension is a cause of many diseases and complications (Secretariat General of Health Departement, 2012, Mendis, 2013).

Medicinal herbs have been used by people to prevent and cure of their hypertension, i.e. in Southeast of Sulawesi they called Dana (*Imperata cylindrica*) root (Hutapea, 1994, Dalimarta, 2006), which is a weed (FAO, 1994).

The other activities of Dana (or *Imperata cylindrica*) root which have been published are: it had anti-inflamatory activity and in traditional medicinal plants it was used for fever (Apu, 2012), in ethno-medicinal plant it was used in liver disease (Dutt, 2012), the methanol extract showed anthelmintic activity at concentration 80mg/ml, in 3.3 min caused paralysis and death in 6.0 min, in "the preliminary phytochemical analysis of extract was indicated the presence of various phytoconstituents which tannins and saponins might have contributed for the potent activity anthelmintic" (Parvathy, 2012).

This study aims to test antihypertensive effect of methanol extract of *Imperata cylindrica* root on Wistar rats, by tail-cuff method for measuring systolic pressure.

The extract and reference drug were given after rats were became hypertension with oral sodium chloride solution. Blood pressure measurement was done with tail-cuff instrument, a non invasive method of measuring blood pressure indirectly on animals. The tail-cuff was recorded as two parameters heartbeat frequency and amplitude of the stroke volume of the heart, where both parameter is directly related to blood pressure, according with the following equation:

The blood pressure ~ Cardiac output and total peripheral resistance, and

Cardiac output = Stroke Volume × Heart Rate

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Table 1a: Amplitude of heart stroke volume male rats during induced hypertension and treatment with methanol extract of *Imperata cylindrica* L. root

Group of treatment	The average value of the amplitude of the cardiac stroke volume (mV) mice on day					
	D_0 (0 hours)	D_3 (72 hours)	D_7 (168 hours)	D_{10} (240 hours)	D_{14} (336 hours)	
					D_{14} (0 hours)	D_{14-4} (4 hours)
I. Control (0 mg/kg bb)	6.61±1.13	7.61±0.52	7.67±0.87	8.31±1.21	7.98±2.29 (0.0 %)	8.86±0.98 (19.3 %)
II. Reference Amlodipin (0,45 mg/kg bb)	5.92±1.01	5.82±1.10	8.15±1.27	7.73±1.10	8.06±0.75 (0.0 %)	6.85±1.19 (-13.9 %)*
III. Reference Kaptopril (2.25 mg/kg bb)	6.38±0.76	7.65±0.64	8.43±2.27	7.59±1.06	8.08±2.17 (0.0 %)	6.88±1.59 (-13.1 %)*
IV. Methanol extract *Imperata cylindrical* at the dosage 60 mg/kg bb	7.08±1.07	7.69±1.05	8.02±1.07	8.02±0.95	8.17±0.96 (0.0 %)	7.21±2.02 (-12.8 %)*
V. Methanol extract *Imperata cylindrical* at the dosage 90 mg/kg bb	6.19±0.93	7.66±1.59	6.74±1.31	6.88±1.20	7.93±0.83 (0.0 %)	6.99±2.99 (-10.7 %)**
VI. Methanol extract *Imperata cylindrical* at the dosage 115 mg/kg bb	7.42±0.79	7.65±1.47	7.51±0.92	7.68±0.48	7.66±1.54 (0.0 %)	7.69±2.12 (0.9 %)

Note : - NaCl were given twice/day
- Test was done after 14 days: D14-4 IS 4 hours after given the 1st therapy.
- D_{14} - D_{27}: future therapeutic treatment and NaCl administration
- *: Significantly different from the control ($p < 0.05$)
- **: significantly different from the control ($p < 0.1$)
- ( ):% Difference in the value of D_{14};
- **: Calculated since the first therapy

Table 1b: Amplitude of heart stroke volume male rats during induced hypertension and treatment with methanol extract of *Imperata cylindrica* L. root

Group of treatment	The average value of the amplitude of the cardiac stroke volume (mV) mice on day				
	D_{15} (24 hours D_1)**	D_{17} (72 hours D_3)**	D_{20} (144 hours D_6)**	D_{24} (240 hours D_{10})**	D_{28} (336 hours D_{14})**
I. Control (0 mg/kg bb)	8.09±1.41 (3.8 %)	8.39±0.39 (8.0 %)	8.85±2.16 (13.3 %)	7.21±0.39 (-5.1 %)	8.50±0.39 (11.8 %)
II. Reference Amlodipin (0,45 mg/kg bb)	6.65±1.28 (-16.4 %)**	7.86±0.77 (-0.4 %)	7.85±1.03 (-1.2 %)	7.49±0.57 (-6.3 %)	7.56±0.77 (5.8 %)**
III. Reference Kaptopril (2.25 mg/kg bb)	7.33±0.98 (-5.3 %)	7.84±1.10 (-9.9 %)	8.16±1.5 (3.8 %)	7.73±1.12 (-1.75 %)	6.61±1.48 (-14.9 %)*
IV. Methanol extract *Imperata cylindrical* at the dosage 60 mg/kg bb	7.94±0.92 (-1.4 %)	8.61±1.17 (0.8 %)	7.10±1.67 (-13.3 %)*	7.46±1.18 (-8.5 %)	6.76±1.12 (-17.3 %)*
V. Methanol extract *Imperata cylindrical* at the dosage 90 mg/kg bb	7.06±1.71 (-10.5 %)	7.02±0.59 (-10.1 %)	6.34±0.89 (-19.8 %)*	7.33±1.16 (-6.9 %)	7.01±1.23 (-11.3 %)*
VI. Methanol extract *Imperata cylindrical* at the dosage 115 mg/kg bb	7.90±1.52 (4.0 %)	7.69±1.39 (-4.9 %)	8.31±1.84 (10.1 %)	8.23±1.22 (13.1 %)	7.61±1.32 (0.8 %)

Note : - NaCl were given twice/day
- Test was done after 14 days: D14-4 IS 4 hours after given the 1st therapy.
- D_{14} - D_{27}: future therapeutic treatment and NaCl administration
- *: Significantly different from the control ($p < 0.05$);
- **: significantly different from the control ($p < 0.1$)
- ( ):% Difference in the value of D_{14};
- **: Calculated since the first therapy

Table 2a: Heart rate frequency of male rats during the induction of hypertension and treatment with methanol extract of *Imperata cylindrica* L. Root

Group of treatment	The average frequency of heart rate (beats / min) on day					
	D_0 (0 hours)	D_3 (72 hours)	D_7 (168 hours)	D_{10} (240 hours)	D_{14} (336 hours)	
					D_1 (0 hours)	D_{14} (4 hours)
I. Control (0 mg/kg bb)	179.8± 45.90	175.6± 14.50	190.0± 16.06	139.0± 22.77	153.8± 34.95 (0.0 %)	180.0± 23.31 (21.2 %)
II. Reference Amlodipin (0.45 mg/kg bb)	168.83± 40.31	160.67± 53.79	157.0± 43.44	177.5± 43.79	196.17± 30.06 (0.0 %)	176.33± 31.99 (-7.8 %)
III. Reference Kaptopril (2.25 mg/kg bb)	161.83± 23.76	160.5± 16.21	165.0± 42.43	168.33± 56.81	167.17± 38.29 (0.0 %)	148.5± 26.74 (-7.4 %)
IV. Methanol extract *Imperata cylindrical* at the dosage 60 mg/kg bb	168.0± 51.51	158.67± 32.35	171.17± 23.49	198.5± 55.02	184.83± 11.18 (0.0 %)	157.0± 30.65 (-15.2 %)*
V. Methanol extract *Imperata cylindrical* at the dosage 90 mg/kg bb	139.33± 68.13	152.83± 42.27	140.67± 30.22	166.67± 18.86	199.33± 27.22 (0.0 %)	153.17± 62.54 (-20.5 %)*
VI. Methanol extract *Imperata cylindrical* at the dosage 115 mg/kg bb	176.33± 25.41	175.33± 33.58	143.17± 38.25	171.50± 31.51	186.33± 24.6 (0.0 %)	177.5± 70.81 (-4.0 %)

Note : - NaCl were given twice/day
- Test was done after 14 days: D14-4 IS 4 hours after given the 1st therapy.
- D14 – D27 : was the time of the therapy and the hypertension induction by NaCl.
- *: Significantly different from the control ($p < 0.05$);
- **: significantly different from the control ($p < 0.1$)
- ( ):% Difference in the value of D_{14}
- **: Calculated since the first therapy

Thus the increase of frequency and amplitude of stroke volume of heart showed increased blood pressure (hypertension) (Krege, 1995, Lerman, 2005, Malkoff, 2005, Amalia, 2008).

METHOD

Material
Tested extract: methanol extract of *Imperata cylindrica* (L.) Beauv. root.

NaCl, distilled water, references drug amlodipine and captopril tablets (OGB Dexa)

Equipment: Tail cuff MP 100 Pulse Transducer (AD Instruments)

At the beginnings and the ends of induction, and treatment were measured amplitude of heart stroke volume and heart rate frequency, where in both values increased in hypertensive condition.

Drugs with anti-hypertensive activity will decrease both the amplitude of cardiac stroke volume and frequency of the heart rate.

Rats were divided into seven groups:

a. Group 1: negative control (normal rats, not induced and not treated)

b. Group 2: positive control (induced but not treated)

c. Group 3: reference amlodipine dose 0.45 mg/kg-bw

d. Group 4: reference captopril dose 2.25 mg/kg-bw

e. Group 5: methanol extract of *Imperata cylindrica* roots at dose 60 mg/kg-bw

f. Group 6: methanol extract of *Imperata cylindrica* roots at dose 90 mg/kg-bw

g. Group 7: methanol extract of *Imperata cylindrica* roots at dose 115 mg/kg-bw.

The measurement of cardiac output and total peripheral resistance were done at days: 0, 3-, 7-, 10- and 14-days during induction of hypertension.

The 14th day is the beginning of therapy was done twice measurement of cardiac stroke volume and frequency of the heart rate, which were before and 4 hours after administration of therapy (the methanol extracts and references).

Measurement was continued on days 15, 17, 20, 24 and 28

Induction of hypertension with oral administration of NaCl solution was done twice daily during the experimentation.

Table 2b: Heart rate frequency of male rats during the induction of hypertension and treatment with methanol extract of *Imperata cylindrica* L. root

Group of treatment	The average frequency of heart rate (beats / min) on day				
	D_{15} (24 hours D_1)**	D_{17} (72 hours D_3)**	D_{20} (144 hours D_6)**	D_{24} (240 hours D_0)**	D_{28} (336 hours D_{14})**
I. Control (0 mg/kg bb)	158.4± 33.37 (7.31 %)	184.0± 17.22 (25.0 %)	169.2± 17.70 (14.4 %)	164.4± 42.22 (8.6 %)	179.0± 22.34 (21.8 %)
II. Reference Amlodipin (0,45 mg/kg bb)	162.17± 26.48 (-14.61 %)	150.0± 41.45 (-22.8 %)*	125.17± 30.0 (-35.9 %)*	157.33± 36.61 (-18.07 %)**	167.17± 26.33 (-14.24 %)*
III. Reference Kaptopril (2.25 mg/kg bb)	171.67± 39.12 (4.2 %)	169.0± 20.46 (-1.2 %)	163.0± 49.79 (0.1 %)	144.17± 33.54 (-11.2 %)	124.83± 22.9 (-20.06 %)*
IV. Methanol extract *Imperata cylindrical* at the dosage 60 mg/kg bb	179.83± 25.06 (-2.7 %)	184.5± 18.27 (-0.7 %)	169.33± 34.19 (-8.0 %)	179.83± 19.36 (-2.1 %)	163.67± 32.568 (-11.1 %)*
V. Methanol extract *Imperata cylindrical* at the dosage 90 mg/kg bb	147.17± 26.73 (-24.5 %)*	152.0± 33.71 (-21.3 %)*	178.0± 85.37 (-5.9 %)	166.0± 27.44 (-14.8 %)**	152.67± 37.27 (-20.9 %)*
VI. Methanol extract *Imperata cylindrical* at the dosage 115 mg/kg bb	187.0± 33.63 (2.7 %)	192.8± 42.83 (8.2 %)	138.0± 36.68 (-25.2 %)*	171.33± 18.18 (-6.7 %)	191.67± 59.12 (3.0 %)

Note : - NaCl were given twice/day
- Test was done after 14 days: D14-4 IS 4 hours after given the 1st therapy.
- D14 – D27 : was the time of the therapy and the hypertension induction by NaCl.
- *: Significantly different from the control ($p < 0.05$);
- **: significantly different from the control ($p < 0.1$)
- ( ):% Difference in the value of D_{14}
- **: Calculated since the first therapy.

The data were processed statistically by Anova and student-t.

RESULT AND DISCUSSION

Method of blood pressure were measured by noninvasive, therefore blood pressure changes can be observed in a continuous.

The test was done with blood pressure indirect measurement which was based on the frequency of heart rate and stroke volume amplitude.

Measurement of heart rate frequency and stroke amplitude can be done to overcome the blood pressure measurement, because both have correlations with blood pressure, and the equation were

The blood pressure ~ cardiac output and total peripheral resistance (1)

Cardiac output = stroke volume x heart rate (2)

The equation above shows that blood pressure can be increased if one factors: cardiac output or total peripheral resistance increases, or both factors at the same time equally increased.

The test can observe the changed of cardiac output by measurements of stroke volume and heart rate.

A. Induction of Hypertension

Sodium chloride (NaCl) given during 28 days, from the beginning of the hypertension induction until the end of treatment. This condition produced animal models hypertension and to maintain the condition of hypertension until the end of treatment.

The rat received 3.75 g/kg bw NaCl solution as divided doses and gave orally twice daily during 28 days.

In this study, at 14 days after administration of saline solution obtained hypertension, rats, and then treated with *Imperata cylindrica* root extract and reference drug for 14 days. Induction with NaCl solution was continued therapy with extract and reference drug that administered orally once a day.

Results show all average amplitude heart stroke volume and heart rate of hypertension rat, increased significantly compared to controls. These results indicate that hypertension induced by administration of NaCl produced rat model of hypertension by increasing the

amplitude of heart stroke volume and heart rate. These rats used for next experiment, treatment step.

B. Therapy Duration

At the 14th day induction period until the 14th day of the duration of therapy (called D_{28}), frequency of heart rate and stroke volume amplitude measured by a tail cuff method.

The observations were done at days: D_0, D_{15}, D_{17}, D_{20}, D_{24}, and D_{28} (14 days after treatment).

Amlodipine and captopril were used as reference drugs, because the drug are a calcium channel antagonist anti-hypertensive classes that play a role as the decrease of peripheral resistance and an the increase of cardiac index. Calcium channel antagonists worked by blocking selectively of L type calcium channel so that input Ca^{2+} ions through the membrane into the cells of the heart and vascular smooth muscle is inhibited, so that the process of excitation-contraction was inhibited and occurs of vasodilation coronary and peripheral. Amlodipine dose was 0.45 mg/kg-bw rat, which the dose was conversion from normal of human therapeutic dosage to rat.

The second reference was used captopril 2.25 mg/kg bw rat (which the dose was conversion from normal of human therapeutic dose to rat). Captopril inhibited of enzymes that play a role in the conversion of angiotensin I to angiotensin II (ACE), thus reduced blood pressure due to angiotensin II as vasoconstrictor.

Table I, at D_{14-4}, 4 hours after drug reference and tested extract were given, the amplitude of cardiac stroke volume was significantly decreased compared to control, there were amlodipine group by 13.9% ($p<0.05$), captopril by 13.1%, ($p<0.05$), methanol extract at the dose 60 mg/kg-bw by 12.8%, ($p<0.05$), and 90 mg/kg-bw by 10.7 %, ($p<0.05$), where the control group increased by 19.3%. At the D_{15} and D_{28} the amplitude of cardiac stroke volume of amlodipine group decreased, by 16.4% ($p<0.1$) and 5.8% ($p<0.1$) respectively. At the D_{28} the amplitude of cardiac stroke volume showed on captopril group increased by 14.9% ($p<0.05$), tested extract at the doses of 60 and 90 mg/kg-bw increased 17.3% and 11.3% respectively, both were significantly ($p<0.05$).

Table II, the result of the heart rate, amlodipine group at D_{17}, D_{20}, D_{24}, and D_{28}, showed the significant reduction by 22.8% ($p<0.05$), 35.9% ($p<0.01$), 18.07% ($p<0.1$) and 14.24% ($p<0,01$) respectively. Captopril showed the significant reduction on D_{28} which was by 20.06% ($p<0,01$)

At D_{14-4} the tested group 4 hours after received tested extract at the dose of 60 mg/kg-bw decreased heart rate was 15.2% ($p <0.05$), at D_{28} was 11.1% ($p<0.05$), and the dose of 90 mg/kg-bw at D_{14-4} was 20.5% ($p<0.05$), D_{15} was 24.5% ($p<0.05$), D_{17} was 21.3% ($p<0.05$), D_{24} was 14.8% ($p <0.1$), and at D_{28} was 20.9% ($p<0,05$).

At the dosage 115 mg/kg-bw showed the suppression of heart rate was 25.2% at D_{20} ($p<0,05$).

CONCLUSION

References drugs amlodipine and captopril gave anti-hypertensive effect with the reduction of the two parameters, amplitude of cardiac stroke volume and frequency of heart rate, although the significantly at certain days of observation.

The tested extract, methanol extract of *Imperata cylindrical* (L.) Beauv. roots at a dose of 90 mg/kg bw showed a better antihypertensive effect than the dose of 60 mg/kg bw which the frequency of heart rate more reduced.

At the higher dose 115 mg/kg bw, methanol extract of *Imperata cylindrica* roots did not show an increase the effect than the lower doses.

REFERENCE

Amalia L, Dissertation: Study of antihipertension of ethanol extract of *Allium Schoenoprasum* L. tuber. Bandung: School of Pharmacy, Bandung Institute of Technology, 2008.

Apu AS, Bhuyan SH, Prova SS, Muhit AM. 'Anti-inflammatory activity of medicinal plants native to Bangladesh', J App Pharm Sci, vol. 2, no. 2, February 2012 pp. 7-10.

Dalimarta S., Atlas of Indonesian Medicinal Plants: *Imperata cylindrical* [L.] Beauv. No.4, Depok: Puspa Swara, 2006 pp.1-3.

Dutt R, Pushpan R, Kumari H, Nishteswar K. 'Cirrhosis of liver-care by indigenous and folk herbal medicine', vol.3, no. 2, February 2012 pp. 1-3.

Food and Agriculture Organization of The United Nations., Weed Management for Developing Countries, Chapter 2. Problem weeds and their management in crops and non-crop situations: Characteristics and management of Imperata cylindrica (L.) Raeuschel in smallholder farms in developing countries, FAO 1994.

Hutapea JR, Djumidi, Sutjipto., Indonesia medicinal plants inventory (III): *Imperata cylindrica* Beauv., 1st edition, Jakarta: Ministry of Health Republic of Indonesia, 1994 PP.103-4.

Krege JH, Hodgin JB, Hagaman JR, Smithies O. 'A noninvasive computerized tail-cuff system for measuring blood pressure in mice', Hypertension; vol. 25: no.5, May,1995, pp.1111-5.

Lerman LO, Chade AR, Sica V, Napoli C: Animal models of hypertention', J Cab Clin Med; vol. 146, no. 3, September, 2005 pp. 161-8

Malkoff J. 'Non Invasive Blood Pressure for Mice and Rats', ALN Magazine; Mon, October 31, 2005.

Mendis S. 'Hypertension: a silent contributor to the global cardiovascular epidemic', WHO, Regional Health Forum; vol. 17, no. 1, 2013 pp. 1-6.

Parvathy NG, Padma R, Renjith V, Rahate KP, Saranya TS. 'Phytochemical screening and anthelmintic activity of methanolic extract of *Imperata cylindrica*', IJPPS, vol. 4, supp. 1, March 2012 pp. 232-4.

Public Communication Center of Secretariat General of Health Departement. 'Hypertension problem in Indonesia. Jakarta: Ministry of Health Republic of Indonesia, May 2012.