PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 7 (1): 130-132, 2008
ISSN 1680-5194

Effect of *Acalypha wilkesiana* Muell Arg on Plasma Sodium and Potassium Concentration of Normal Rabbits

Ikewuchi, Jude Chigozie[1], Anyadiegwu, Amaka[2],
Ugono, Erhieyovwe Yovwe[1] and Okungbowa, Solomon Osas[1]
[1]Department of Basic Sciences, Faculty of Basic and Applied Sciences,
Benson Idahosa University, Benin City, Edo State, Nigeria
[2]Department of Microbiology, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria

Abstract: The effect of *Acalypha wilkesiana* leaves on plasma levels of sodium and potassium were studied in normal rabbits given daily, by intra-gastric gavage, 1g/kg of the leaf, in the form of decoction prepared by mixing 5g of air-dried powdered leaves in 10 mL water. The treatment led to significant decreases ($p<0.05$) in plasma sodium concentrations and significant increases in potassium concentrations. These findings connote a therapeutic advantage in the use of *A. wilkesiana* for the treatment of hypertension, especially in managing the abnormal sodium and potassium metabolisms that accompany hypertension.

Key words: *Acalypha wilkesiana*, hypertension, potassium-sparing diuretic

Introduction

Acalypha wilkesiana Muell Arg, belongs to the Euphorbiaceae family. Relatively few studies have mentioned the phytochemical constituents of *A. wilkesiana*. Akinde (1986) reported the presence of sesquiterpenes, monoterpenes, triterpenoids and polyphenols, while Adesina *et al*. (2000) reported the presence of gallic acid, corilagin, geraniin, quercetin 3-0-rutinoside and kaempferol 3-0-rutinoside in the leaves of *A. wilkesiana*. In another study, Oladunmoye (2006) reported the presence of saponins, tannins, anthroquinone and glycoside in the leaves of *A. wilkesiana*.

A. wilkesiana has antibacterial and antifungal properties (Akinde, 1986; Alade and Irobi, 1993; Adesina *et al*., 2000; Ogundaini, 2005; Oladunmoye, 2006). The expressed juice or boiled decoction is used for the treatment of gastrointestinal disorders and fungal skin infections such as *Pityriasis versicolar*, *Impetigo contagiosa*, *Candida intetrigo*, *Tinea versicolor*, *Tinea corporis* and *Tinea pedis* (Akinde, 1986; Ogundaini, 2005). In traditional medicine, the leaves of this diuretic plant are eaten as vegetables in the management of hypertension. In this study, the effect of *A. wilkesiana* on plasma sodium and potassium levels, was investigated for therapeutic benefits.

Materials and Methods

Eight, 3-month old New Zealand white rabbits weighing between 0.8-1.8 Kg were obtained from a breeder in Benin City. The animals were housed in clean, disinfected hutches and acclimatized on guinea growers mash (product of Bendel Feed and Flour Mills, Ltd; Ewu, Nigeria) for a week, after which they were weighed and randomly assigned into two groups (four per group), with an average weight difference of 0.2kg. The baseline plasma sodium and Potassium concentrations were determined prior to administration. The test group, orally received, each day, 1g/kg of the leaf in the form of a decoction prepared by mixing 5g of air-dried powdered leaves in 10 mL of water. The control group received appropriate volumes of water through the same route. Mash and water were provided *ad libitum*. The rabbits were weighed weekly to allow for adjustments in administration of the concoction. The treatment lasted for fifteen days and blood samples were collected on day 0 (baseline), 1, 8 and 15, for determination of plasma sodium and potassium levels.

The determination of plasma levels of sodium and potassium was done by flame photometry, at the Biochemistry department, Central Hospital Benin, Benin city, Nigeria.

All values are quoted as the mean±S.E.M. Data were analyzed using the Student's t test.

Results

Table 1 shows the effect of the aqueous concoction of *A. wilkesiana* on plasma sodium concentrations. There was a slight reduction ($p<0.10$) from baseline level on day 1, after which the reduction became significant ($p<0.05$) on day 8 and 15. At all times during the treatment, the plasma sodium concentrations of the treated group were always significantly lower ($p<0.05$) than that of the control. The effect of the concoction on plasma potassium concentrations is given in Table 2. The plasma potassium concentration of the treated animals, after receiving the treatment, were significantly higher ($p<0.05$) compared to the control and baseline values.

Table 1: Time course of the effect of the aqueous leaf preparations of *A. wilkesiana* on plasma sodium concentrations of normal rabbits

	Plasma sodium concentration mg/dL	
Time	Control	Test
Day 0 (Baseline)	132.25±1.80	132.25±2.84
Day 1	130.25±1.11	128.00±1.00*,+
Day 8	128.00±0.71	117.00±1.73*,+
Day 15	124.75±1.43	121.25±0.85*,+

Sodium concentrations are expressed as mean±S.E.M., *P<0.05 compared to control, n = 4, per group, +P<0.05 compared to baseline, n = 4, ++P<0.10 compared to baseline, n = 4

Table 2: Time course of the effect of the aqueous leaf preparations of *A. wilkesiana* on plasma potassium concentrations of normal rabbits

	Plasma potassium concentration mg/dL	
Time	Control	Test
Day 0 (Baseline)	3.75±0.21	3.80±0.14
Day 1	3.50±0.21	4.75±0.29*,+
Day 8	3.38±0.17	8.80±0.26*,+
Day 15	3.23±0.11	4.20±0.18*,+

Sodium concentrations are expressed as mean±S.E.M., *P<0.05 compared to control, n = 4, per group, +P<0.05 compared to baseline, n = 4

Discussion

Diuretics may be used to treat hypertension as well as edema (Kokko, 1984; Brater, 1998; Rang *et al.*, 2005). They function primarily to induce a net negative balance of solute and water. Potassium-sparing diuretics inhibit either aldosterone directly or the Na^+/K^+ exchange mechanisms in the distal tubules and collecting ducts (Kokko, 1984; Rang *et al.*, 2005; Crook, 2006; Burton and Theodore, 2007). The net effect is the loss of sodium in the urine and the retention of potassium in the blood, with the resultant decrease in plasma sodium and increase in plasma potassium levels. In this study, the leaf concoction reduced plasma sodium level and increased plasma potassium levels. This implies that it is a potassium-sparing diuretic and may either act by inhibiting aldosterone directly or the Na^+/K^+ exchange mechanisms in the distal tubules. According to Dmitrieva and Doris (2002), inhibition of Na^+/K^+ ATPases in the kidney, facilitates renal sodium excretion.

Earlier, Oladunmoye (2006) reported that the mechanism of antimicrobial activities of *A. wilkesiana* is the release of sodium and potassium ions. This surely points to the fact that the extract affects sodium and potassium pumps or Na^+/K^+ ATPases. This point is further strengthened by the fact that *A. wilkesiana* contains flavonoids, a family of compounds that are known to inhibit Na^+/K^+ ATPases (Hirano *et al.*, 1989; Rouzaire-Dubois *et al.*, 1993; Roufogalis *et al.*, 1999; Middleton *et al.*, 2000). All of these remain to be experimentally validated in this case.

Finally, the effect observed in this study may be beneficial in the management of hypertension, since hypertension is characterized by high plasma sodium and low plasma potassium levels (Luscher *et al.*, 1987; Komiya *et al.*, 1997; Coruzzi *et al.*, 2001).

References

Adesina, S.K., O. Idowu, A.O. Ogundaini, H. Oladimeji, T.A. Olugbade, G.O. Onawunmi and M. Pais, 2000. Antimicrobial constituents of the leaves of *Acalypha wilkesiana* and *Acalypha hispida*. Phytotherapy Res., 14: 371-374.

Akinde, B.E., 1986. Phytochemical and Microbiological Evaluation of the oils from the Leaves of *Acalypha wilkesiana*. In: Sofowora A, editor. The State of Medicinal Plant Research in Nigeria. University of Ibadan Press, Nigeria, pp: 362-363.

Alade, P.I. and O.N. Irobi, 1993. Antimicrobial activities of crude leaf extracts of *Acalypha wilkesiana*. J. Ethnopharmacol., 39: 171-174.

Brater, D.C., 1998. Diuretic Therapy. N. Engl. J. Med., 333: 387-395.

Burton, D.R. and W.P. Theodore, 2007. Mechanism of action of diuretics. UpToDate, pp: 15.1. http://patients.uptodate.com/topic.asp?file=fldlytes/25960. (accessed July, 2007).

Coruzzi, P., L. Brambilla, V. Brambilla, M. Gualerzi, M. Rossi, G. Parati, M. Di Rienzo, J. Tadonio and A. Novarini, 2001. Potassium Depletion and Salt Sensitivity in Essential Hypertension. J. Clin. Endocrinol. Metabol., 86: 2857-2862.

Crook, M.A., 2006. Clinical Chemistry and Metabolic Medicine. 7th Edn. Hodder Arnold, London, pp: 84.

Dmitrieva, R.I. and P.A. Doris, 2002. Cardiotonic Steroids: Potential Endogenous Sodium Pump Ligands with Diverse Function. Exptl. Biol. Med., 227: 561-569.

Hirano, T., K. Oka and M. Akiba, 1989. Effects of synthetic and natural flavonoids on Na^+,K^+-ATPases: Aspects of the structure activity relationship and action mechanism. Life Sci., 45: 1111-1117.

Kokko, J.P., 1984. Site and Mechanism of action of diuretics. Am. J. Med., 77: 11-17.

Komiya, I., T. Yamada, N. Takasu, T. Asawa, H. Akamine, N. Yagi, Y. Nagasawa, H. Ohtsuka, Y. Miyahara, H. Sakai, H. Sato and T. Aizawa, 1997. Abnormal Sodium Metabolism in Japanese Patients with Essential Hypertension, Judged by Serum Sodium Distribution, Renal Function and the Renin-Aldosterone System. J. Hypertens., 15: 65-72.

Luscher, T.F., P.M. Vanhoutte and L. Raij, 1987. Antihypertensive treatment normalizes decreased endothelium-dependent relaxation in rats with salt-induced hypertension. Hypertension [suppl. III], 111: 193-197.

Middleton, R. Jr., C. Kandaswami and T.C. Theoharides, 2000. The Effects of Plant Flavonoids on Mammalian Cells: Implications for Inflammation, Heart Disease and Cancer. Pharmacol. Rev., 52: 673-751.

Ogundaini, A.O., 2005. From Greens Into Medicine: Taking a Lead From Nature. An Inaugural Lecture Delivered at Oduduwa Hall, Obafemi Awolowo University, Ile-Ife, Nigeria. Inaugural Lecture Series 176. OAU Press Limited, Ile-Ife, Nigeria, pp: 12-15.

Oladunmoye, M.K., 2006. Comparative Evaluation of Antimicrobial Activities and Phytochemical Screening of Two Varieties of *Acalypha wilkesiana*. Trends in Appl. Sci. Res., 1: 538-541.

Rang, H.P., M.M. Dale, J.M. Ritter and P.K. Moore, 2005. Pharmacology. 5th Edn. Elsevier, India, pp: 300, 362-365.

Roufogalis, B.D., L.I. Qian, V.H. Tran, P.W. Kable and C.C. Duke, 1999. Investigation of plant-derived phenolic compounds as plasma membrane $Ca2^{+}$-ATPase inhibitors with potential cardiovascular activity. Drug Dev. Res., 46: 235-249.

Rouzaire-Dubois, B., V. Gerard and J.M. Dubois, 1993. Involvement of K^{+} channels in the quercetin-induced inhibition of neuroblastoma cell growth. Pfluegers Arch., 423: 202-205.