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Antihypertensive Properties of the Root and Stem Bark of Nauclea Latifoia – Serum Electrolyte Profile

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ABSTRACT

Hypertension is a relatively common disorder that is probably the most important public health problem in developed countries. It is common, asymptomatic, readily detectable, usually easily managed and usually leads to lethal complications if left unmanaged. This study evaluates the antihypertensive properties of the root and stem of *Nauclea latifolia*, by assessing the serum electrolytes levels in hypertensive animals treated with the extracts. The stem extract produced a significant decrease ($p<0.05$) of sodium in the treated animals compared to that of the hypertensive. The chloride levels in the treated and control groups were not significant ($p>0.05$), and the potassium levels were insignificant in the treated and control groups ($p>0.05$). Also, the potassium levels for the root extract treated animals were insignificantly lower ($p>0.05$) than the controls, while the sodium and chloride levels were significant ($p<0.05$). The reduced levels of these electrolytes, especially sodium showed that the *N. latifolia* extracts have antihypertensive properties.

KEYWORDS: *Nauclea latifolia, antihypertensive properties, serum electrolytes.*

1. INTRODUCTION

Medicinal plants have served as valuable starting materials for drug development in both developing and developed countries [1]. Today, more than 80 per cent of the people living in Africa depend on medicinal plants and animal based medicines to satisfy their healthcare requirements [2]. Nauclea latifolia (family Rubiaceae) is a valuable medicinal plant that is widespread in the humid tropical rainforest zone or in savannah woodlands of West and Central Africa. It is known as African peach and may be used for traditional medicinal practices of the East and West African sub-regions of continental Africa [3]; where various extracts of the plant are used for the therapeutic management of malaria [4]; hypertension [5]; prolonged menstrual flow [6]; cough, gonorrhoea, stomach disorders, dysentery, ulcers and liver ailments [7]. The use of the plant in most of these conditions had been scientifically investigated and validated in studies that utilize various parts of the plant. For instance, the cardiovascular, spasmolytic, anti-plasmodial and anti-parasitic effects have been reported in studies that used various laboratory models [8, 9, 10, 4, 11, 12, 13, 14]. Laboratory studies have also provided evidence for possible sedative activities of *Nauclea latifolia* [15]. Previous studies had suggested that the leaf of *Nauclea latifolia* possesses an anti-hypertensive effect [16, 17].

2. MATERIALS AND METHODS

Chemicals

Biochemical assay kits used in this analysis were obtained from DIALAB Production and Vertrieb Von Chemisch-technischen Produkten und Laborinstumenten Gesellschaff M. B. H, A-1160 Wien-Panikengasse. Other chemicals include; N_{ω}-Nitro-L-arginine methyl ester hydrochloride (L-NAME), obtained from Cayman Chemical Company Inc, 1180 East Ellsworth Road, Ann Arbor, ML 48108, USA. Captopril, obtained from Unical Pharmacy, University of Calabar, Calabar, Cross River State-Nigeria. Chloroform, Dimethyl sulphoxide, Normal saline and Distilled water.

Collection and Preparation of Plant Materials

The root and stem of pin cushion tree (*Nauclea latifolia*) were collected from the Teaching Hospital premises of the University of Calabar, Calabar in Cross River State-Nigeria. The plant was authenticated by the Department of Botany, Faculty of Sciences, University of Calabar. The plant parts were washed thoroughly with tap water and then rinsed with distilled water. The barks were divested and chopped into small pieces and dried under shade. They were blended into fine powder using a Q-link electrical blender Model QBL-18L40. Three hundred and ten point eight grams

(310.8g) of the blended stem bark and Three hundred and sixty grams (360g) of the blended root barks were separately soaked in 1200ml of ethyl alcohol (80% BDH) each and agitated, then allowed to stay in refrigerator for 48 hours at 4^{o}C. The mixtures were first filtered with cheese cloth, then with WhatMan No 1 filter paper (24cm). The filtrates were separately concentrated *in vacuo* using Rotary Evaporator (Model RE52A, China) to 10% of its original volume at 37^{o} C - 40^{o} C. These were concentrated to complete dryness in water bath, yielding 37.1g (11.96%) of stem bark and 49.1g (13.6%)

of root bark extracts. The extracts were stored in a refrigerator from where aliquots were reconstituted for antihypertensive screening.

Laboratory Animals

Matured male and female albino wistar rats were obtained from the Animal House of the Department of Zoology University of Calabar. They were maintained with rat chow (Vital Feeds LMT) and water *ad libitum*. The animals were housed, five in a cage and were exposed to 12 hour light-dark cycle and handled according to standard protocol. After the acclimatization period of two weeks, the animals were divided into two batches; treatment1 and treatment 2. Also a standard control group received 20mg/Kg bw of a standard drug, Captopril. All the treated groups and the hypertensive control group simultaneously received 40mg/Kg bw of a hypertensive agent (N_{ω}-Nitro-L-arginine methyl ester hydrochloride, L-NAME), while the normal control group received 50% Dimethylsulphoxide, for two weeks (14 days).

Determination of Serum Electrolytes

At the end of the treatment period, the animals were anaesthetized in chloroform vapour and the blood collected via cardiac puncture into a plane tube. The blood was allowed a clotting period of two hours and then centrifuged at 3000rpm for ten minutes, using a model 0412-1 centrifuge (Cole medical instrument co.LTD, England). The serum of the centrifuged blood was collected into a clean plane tube using a syringe, and used for electrolyte determination. The electrolyte analysis was done using kits and an AJ-1222 semi-auto Biochemistry Analyzer (Easy way medical equipments LTD, made in England).

Statistical Analysis

The data were analyzed using a one-way ANOVA (in SPSS package) and the results expressed as Mean±standard deviation. All p-values <0.05 were considered significant.

3. RESULT

The results of the electrolyte profile of the antihypertensive properties of the root and stem bark of Nauclea latifolia is presented in tables 1 and 2 below.

The animals fed with the stem bark extract had the Sodium electrolyte level of the normal (104.67±2.47) to be insignificantly lower (P>0.05) than those of treatment 1 (116.01±30.60), treatment 2 (116.76±0.27) and standard/Captopril treated (113.43±0.00) but significantly lower (P<0.05) than that of the hypertensive control (159.04±59.12). Also, the Sodium electrolyte levels of the treated were significantly lower (P<0.05) than that of the hypertensive control. This showed that the extract had a Sodium lowering effects on the animals. The Chloride electrolyte levels took a different trend, with that of the normal (81.28±3.11) being insignificantly higher (P>0.05) than those of hypertensive control and standard/Captopril treated (76.31±3.36 and 71.72±3.79 respectively) and insignificantly lower than those of treatment 1 and treatment 2 (97.78±2.12 and 88.74±1.69 respectively). This trend is however not of any serious consequence since there was a lowering effects on the Sodium electrolytes levels. Similarly, the Potassium electrolyte level for the hypertensive control (6.17±0.39) was insignificantly lower (P>0.05) than those of normal, treatment 2 and standard/Captopril treated (7.80±0.33, 6.67±0.20 and 6.95±0.10) but insignificantly higher than that of treatment 1 (4.87±0.34). In the animals gavaged with the root bark extract, the Sodium electrolyte level for the normal (104.67±2.47) compared favorably and insignificantly (P>0.05) to those of the treated (104.06±23.80, 110.47±36.22 and 113.43±0.00 respectively) and they were significantly lower (P<0.05) than the hypertensive (159.04±59.12). Also, the Chloride electrolyte levels in the treated and hypertensive were insignificantly lower than that of the normal. However, the trend of Chloride electrolyte change in the animals gavaged with the root bark extract was similar to those of the animals gavaged with the stem bark extract. The Potassium electrolyte levels of the root bark gavaged animals took a similar trend with those of the Chloride, the normal being insignificantly (P>0.05) higher than those of hypertensive and treated. These trends however showed that Sodium electrolyte was most implicated in hypertensive condition.

4. DISCUSSION

Serum electrolytes level are some of the most commonly used biochemical indices for the assessment of hypertension [18, 19]. Sodium is the major extracellular electrolyte implicated in hypertension, while Potassium functions in collaboration with other electrolytes such as Calcium and Magnesium for the maintenance of body's homeostasis [19]. Extra cellular Sodium electrolyte level is responsible for the extent to which vessel walls contract [20]. When the Sodium level is high, there is increased contraction of the blood vessels (especially in the kidney), and hence a greater force is required to pump blood, with a consequent hypertension [19]. This study revealed an elevation in Sodium level in the hypertensive control group, but a decrease in Chloride level. However, there was no alteration in the Potassium levels. This is in agreement with [20, 21]; that the electrolyte alteration in hypertension is not directly link to Potassium. This elevation was later ameliorated by the administration of root and stem bark extracts of *Nauclea latifolia*, and the standard drug, Captopril. This confirms the work by [22, 20]; which reported on the anti-hypertensive property of *Nauclea latifolia*. The Potassium and Chloride levels for the controls and treated were within normal range. This may be due to the fact that the extracts have cellular protection properties, with a normal extracellular Potassium level, or it may be due to the fact that these electrolytes are not directly associated with the development of hypertension [21]. Also, the decrease in Chloride levels caused by the extracts is

probably not dose dependent. Also, the extracts showed antihypertensive properties as they were able to considerably lower the Sodium electrolyte levels in hypertensive animals, compared to the controls.

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Table 1: Serum Electrolytes in Rats Treated with Crude Ethanolic Stem Bark Extracts of *Nauclea Latifolia* for 14 Days.

Extract	Treatment	Na^+ (mEq/L)	Cl^- (mEq/L)	K^+ (mEq/L)
Stem extract	Normal control	104.67±2.47	81.28±3.11	7.80±0.33
	Hypertensive control	159.04±59.12	76.31±3.36	6.17±0.39
	Treatment 1 (150mg/Kg)	116.01±30.60	97.78±2.12	4.87±0.34
	Treatment 2 (300mg/Kg)	116.76±0.27	88.74±1.69	6.67±0.20
	Standard treated (20mg/Kg) Captopril	113.43±0.00	71.72±3.79	6.95±0.10

Table 2: Serum Electrolytes in Rats Treated with Crude Ethanolic Root Bark Extracts of *Nauclea Latifolia* for 14 Days

Extract	Treatment	Na^+ (mEq/L)	Cl^- (mEq/L)	K^+ (mEq/L)
Root extract	Normal control	104.67±2.47	81.28±3.11	7.80±0.33
	Hypertensive control	159.04±59.12	76.31±3.36	6.17±0.39
	Treatment 1 (150mg/Kg)	104.06±23.80	58.36±14.83	6.29±0.56
	Treatment 2 (300mg/Kg)	110.47±36.22	68.17±3.38	7.51±0.20
	Standard treated (20mg/Kg) Captopril	113.43±0.00	71.72±3.79	6.95±0.10