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 8 (2): 148-150, 2009
ISSN 1680-5194


# The Effects of Cola Acuminata on Arterial Blood Pressure

E.N.S. Igbinovia[1], A.C. Ugwu[2], A.O. Nwaopara[3]*, H.O. Otamere[1] and W.A. Adisa[1]
[1]Department of Physiology, Ambrose Alli University, Ekpoma, Edo State, Nigeria
[2]Department of Physiology, University of Benin, Benin City, Edo State, Nigeria
[3]Department of Anatomy, Ambrose Alli University, Ekpoma, Edo State, Nigeria

**Abstract:** Caffeine has been proven to be vasoactive and augments the release of calcium from sarcoplasmic reticulum. Interestingly, caffeine is the most active principle of Cola acuminata-commonly consumed in Nigeria. This study is designed to determine its effects on blood pressure using 20 Sprague dawley rats with an average weight of 150g. The animals were subdivided into 2 groups of 10 rats each (control and test groups). The control rats were fed with rat chow while the test groups were fed with salt diet that was prepared by adding 7.7g of salt to 92.3g of normal rats chow in order to achieve hypertension. Substance extraction was by chloroform extraction. With the extract, different levels of the substance concentration were prepared and subsequently infused in sequence to the test rats. The results showed that diastolic blood pressure was more responsive to changes in concentration of Cola acuminata extract with a significant concentration dependent increase in the arterial blood pressure of both the normotensive and hypertensive rats. Considering the fact that Cola acuminata consumption is part of our culture and the fact that some become addicted, it is our opinion therefore, that the need for efforts towards identifying the cardiovascular implications of caffeine containing consumables, can never be over emphasized.

**Key words:** Cola acuminata, caffeine, vasoactive agent, blood pressure

## Introduction

Evidence exist that caffeine has vasoactive properties and as suggested by Fumiko *et al.* (2003), it augments the release of calcium from sarcoplasmic reticulum. Vasoactive agents are considered to be any physiologically occurring or exogenously administered humoral substance that alters the mechanical activity of vasoactive smooth muscles (Bohr *et al.*, 1979). Interestingly, the most active ingredient in Cola acuminata is caffeine (Murray and Pizzorno, 1998). The other ingredients include phenolic compounds: catechin and epicatechin as well as quinic acid, tannic acid and chlorogenic acid (Lee and Jaworski, 1987).

On the potentials of Cola acuminata, Atawodi *et al.* (1995) have analysed its contents for primary and secondary amines as well as the assessment on its methylating potential due to nitrosamine formation. Indeed, there are reports that Cola acuminata is used as a central nervous system stimulant and this focuses on the cerebrospinal centers (Reiling, 1999) and a diuretic -the bases upon which it has been recommended for those with renal diseases; cardiac or renal oedema and rheumatic or rheumatoid conditions (Agatha *et al.*, 1978; Reiling, 1999).

Considering the potentials of Cola acuminata, this study is designed to determine its effects on blood pressure in rats.

## Materials and Methods

**Chloroform extraction:** 300g of Cola acuminata was weighed, chopped and crushed. The crushed product was placed inside the Soxhlet apparatus into which 900m/s of chloroform was added. The soxhlet assembly was then set up and left for 72 hours.

The extracted solution was taken to the oven for concentration to dryness at a regulated temperature of $40^0$C and left for 6 days. The product obtained is a powdery substance. With this, different concentrations of crude extract (0.10mg/ml, 0.25mg/ml, 0.50mg/ml, 1.00mg/ml, 1.50mg/ml and 2.00mg/ml) were prepared.

**Subjects:** 20 Sprague dawley rats with an average weight of 150g were used for this experiment and were allowed to acclimatize for 3 weeks. The animals were subdivided into 2 groups of 10 rats each (Control and Test groups).

For 8 weeks, the control rats were fed with rat chow while the test groups were fed with salt diet that was prepared by adding 7.7g of salt to 92.3g of normal rats chow. The test group diet was mashed in enough water to make for adequate binding and then pressed into lumps. The lumps were then oven dried at $80^0$C. The salt-loading helped the test rats to develop hypertension. However, water was given *ad libitum* to both groups.

**Experimental protocols:** In order to measure blood pressure, the following experimental protocols were carried out and after equilibrium period of about 30-60 minutes.

i. Noradrenaline was infused and then salbutamol to see what effect it would have on the induced contraction.

ii. Acetylcholine was infused; followed by atropine and then different doses of the extract.
iii. Noradrenalin was infused; followed by salbutamol and then different doses of the extract.
iv. Noradrenalin was infused; followed by extract; followed by noradrenaline and then extract again.
v. The extract was infused; followed by noradrenalin; followed by the extract and then noradrenaline.

**Measurement of blood pressure:** This was done before and after the infusion of Cola acuminata extracts. The effects of various agents including the extract were tested. Both the control and test rats were anaesthetized. The trachea was exposed by blunt dissection and cannulated; the left or right common carotid artery was similarly exposed and cannulated for blood pressure; the jugular vein was also exposed and cannulated for infusion of fluids and drugs to determine the in vivo effects. Heparin mixed in normal saline was injected into the cannulated artery to prevent clotting. The arterial cannula was then connected to a pressure transducer connected to an Ugo Basile recorder, for measurement of systolic and diastolic blood pressure.

## Results

The results showed that diastolic blood pressure was more responsive to changes in concentration of Cola acuminata extract (Table 1). A significant concentration dependent increase in the arterial blood pressure of both the normotensive and hypertensive rats was observed (Table 1; Fig. 1). At concentration 0.10mg/Kg and 0.25mg/Kg, the systolic blood pressures were of the same value for the normotensive rats unlike in the case of the hypertensive rats.

In addition, it was also observed that at concentration 1.50mg/Kg, the diastolic blood pressure as well as the mean arterial blood pressure of the normotensive rats dropped but increased afterwards at concentration 2.00mg/Kg (Table 1). Comparatively, at concentration 2.00mg/Kg, the systolic blood pressure of the hypertensive rats dropped (Table 1).

## Discussion

The result of this study has shown that there was varying increase in systolic and diastolic blood pressures following the infusion of Cola acuminata extract. The increase was reflected in both the hitherto normotensive as well as the hypertensive rats. Hence, our results agrees with the report by Fumiko *et al.* (2003) that the decrease reactivity of sarcoplasmic reticulum to caffeine might be a cause of the lesser potentiation of twitch contraction by caffeine in preparations from spontaneously hypertensive and stroke-prone rats.

Indeed, several studies have addressed the distinct cardiovascular effects of caffeine and there are evidence suggesting that an increase in blood pressure

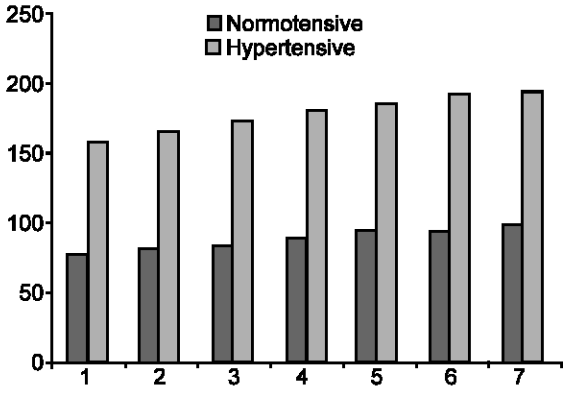


Fig. 1: Response changes in the arterial blood pressure of normotensive and hypertensive rats at different concentration of kola acuminata extract.

consistently follow an acute caffeine administration (Robertson *et al.*, 1978). This is attested to by the reports of Ammon *et al.* (1983), Robertson *et al.* (1984) and Izzo *et al.* (1983) on normotensive individuals, hypertensive individuals and in the elderly, respectively.

Also, various forms of abnormalities of calcium handling have been associated with the hypertensive state (Triggle and Laher, 1985) and there is evidence about structural and functional changes within the blood vessel wall (Webb *et al.*, 1981). Thus, judging from the results of this study and recalling the fact that caffeine is a major principle of cola acuminata (Morton, 1992) as well as the suggestion by Fumiko *et al.* (2003) that a relationship exist between caffeine and the release of calcium, one can see the obvious that there is a significant influence of caffeine (as present in cola acuminata) on the cardiovascular system. This assertion is supported by the reports that high dietary calcium lowers blood pressure in nearly all models of hypertensive rats as well as their normotensive counterparts (Harlan *et al.*, 1984; Gruchow *et al.*, 1986; Trevisan *et al.*, 1986).

Furthermore, as McGrath (1986) has associated noradrenalin function on smooth muscles with the release of calcium and its influx through receptor operated channels, there is a view that the potentiation of contraction as elicited by the addition of Cola acuminata extract at high concentration, may be due to the non availability of channels or very transient opening time of the channels through which the extracts can act. Moreover, Lin and Vassalle (1983) have established that caffeine initially increases the force of contraction via the induction of calcium release from intracellular stores.

Considering the fact that the consumption of Cola acuminata is part of our culture; coupled with the fact that some become addicted, it is our opinion therefore, that the cardiovascular implications of caffeine can not be

Table 1: The Systolic, Diastolic and Arterial Blood Pressure values for normotensive and hypertensive rats

| | Dose (mg/Kg) | Systole (mmHg) | Diastole (mmHg) | Mean Arterial Blood pressure |
|---|---|---|---|---|
| Normotensive Rats | | 83.4±1.0 | 73.4±0.7 | 76.6±0.5 |
| After infusion of extract | 0.10 | 91.0±1.2 | 72.6±1.9 | 81.3±2.9 |
| | 0.25 | 91.0±2.0 | 80.8±1.8 | 84.1±1.7 |
| | 0.50 | 90.7±1.6 | 85.4±2.7 | 88. 2±2.2 |
| | 1.00 | 104.1±1.5 | 91.9±1.3 | 95.9±1.0 |
| | 1.50 | 105.1±1.4 | 90.0±1.8 | 95.2±1.5 |
| | 2.00 | 105.6±2.1 | 94.7±2.3 | 98.1±1.7 |
| Hypertensive Rats | | 169.1±2.5 | 152.3±2.4 | 157.8±1.4 |
| After infusion of extract | 0.10 | 180.3±2.1 | 159.4±2.6 | 166.2±1.5 |
| | 0.25 | 182.4±2.3 | 170.3±2.1 | 174.3±1.9 |
| | 0.50 | 193.9±2.0 | 173.7±2.2 | 180.4±2.0 |
| | 1.00 | 196.1±1.6 | 180.6±1.7 | 185.7±1.3 |
| | 1.50 | 203.0±2.0 | 188.3±2.6 | 193.2±2.0 |
| | 2.00 | 201.6±2.7 | 190.1±2.1 | 194.0±2.2 |

$P < 0.05$

over emphasized. In fact, cerebrovascular accident (CVA) is perhaps the most devastating consequence of increased blood pressure and thus, a habitual consumer of Cola acuminata stands the risk of CVA.

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