

Full length Research Article

Blood Pressure Reducing Effect of Bitter Kola (*Garcinia kola*, Heckel) in Wistar Rats

Naiho A.O. & *Ugwu A.C.

Department of Physiology, Delta State University & University of Benin

ABSTRACT: In this study the effect of *Garcinia kola* (GK) on blood pressure was investigated. Albino wistar rats were divided into three groups. Groups A rats had normal rat chow and water ad-libitum while groups B and C rats had *Garcinia kola* diet of 10% w/w and 15% w/w respectively, their blood pressures were monitored weekly for a period of 6 weeks. Secondly, inbred wistar rats weighing on the average 185g were anaesthetized with thiopentone sodium 100mg/kg body weight (b.wt) intraperitoneally and prepared for injection and for blood pressure measurements on a recording device (Ugo Basile Italy). Significant reduction in blood pressure ($P<0.05$) was observed in rats given GK-enriched diets, in the third week. During preliminary investigations it was observed that 5.0mg/kg b.wt dose of extract was lethal after 6 minutes, while 3.0mg/kg b.wt of the extract was tolerated for upwards of four hours. Based on these findings, graded doses of the extract. (0.5 – 3.0mg/kg) were used and these doses produced statistically significant ($P<0.05$) fall in mean arterial pressure and also significant ($P<0.05$) increase in heart rate. Cholinergic blockade produced no significant attenuation on the effect of extract. However there was a significant ($P<0.05$) attenuation to extract effect after Histaminergic blockade. This study shows that *Garcinia kola* contains in its alcohol extract, a vasoactive substance that has a blood pressure reducing effect.

KEY WORDS: blood pressure, *Garcinia kola*, Vasoactive, Heart rate

INTRODUCTION

Hypertensive disorders are the most common causes of adult morbidity and mortality in Africa. Many workers have discovered many vasoactive substances capable of reducing blood pressure. These include studies on the blood pressure lowering ability of some natural plant materials, such as extracts of garlic, seed of pawpaw (carica papaya), calyx of hibiscus and petals of hibiscus.

Vasoactive agents are considered to be any physiologically occurring or exogenously administered hormonal substance that alters the activity of vascular smooth muscle i.e. that cause its contraction, relaxation, or both. (Bohr et al 1979).

These agents usually act through electrical or non-electrical pathways. It is known that agents such as

acetylcholine, alters membrane permeability and hence change the net diffusion potential, hyperpolarizing the membrane and bringing about relaxation of vascular smooth muscles (Nakajima and Hom 1967). Cholinergic agents, also alters the frequency and other characteristics of the action potential and these alterations cause changes in the mechanical performance of the portal vein (Von Loh, 1971). The cyclic AMP pathway is another process by which some vasodilators bring about relaxation of vascular smooth muscle supportive of this mechanism and this is because the fact that cyclic AMP itself, causes vasodilatation. Anderson (1992) has presented extensive evidence that suggest cyclic AMP stimulates an energy requiring Ca^{2+} binding mechanism that leads to a decreased concentration of sarcoplasmic calcium, and hence relaxation.

Garcinia kola, known as “false” kola, belongs to the order of guterferae and contains pharmacologically

¹ Address for correspondence (acugwu@yahoo.com)

active ingredients. The seeds are used in Nigerian traditional medicine, for therapy of broad spectrum of ailments such as in dysentery and diarrhoea diseases (Braid 1992). There are claims, that traditional medicine practitioners use *Garcinia kola* seeds for the treatment of hypertension. There are also reports that *Garcinia kola*, reduce glutathione concentration, and also inhibits prostaglandin synthesis (Makander 1986). *Garcinia kola* has a spasmolytic effect on gastrointestinal smooth muscle (Briard 1989). It relaxes the smooth muscles of the uterus and gastrointestinal tract. It has been reported to stimulate Histamine dependent gastric acid secretion (Oluwole *et al* 1992). Recently, the antithrombotic activity of GK has been reported (Olajide 1999) and its antibacterial effect on respiratory tract pathogens has also been reported (Akoachere 2002). Elekwa *et al* 2003 reported that aqueous extract of GK stabilized the membranes of HbAA, HbAS and HbSS human erythrocytes and reduced blood viscosity. Also GK have been reported to reduce body weight, reproductive organ weight and inhibit spermatogenesis in male wistar rats (Naiho 2004).

However, no report has been sighted on the effect of *Garcinia kola* on blood pressure, vascular smooth muscle and cardiac muscles. This work aims at investigating the effect of *Garcinia kola* ingestion in rats and its effect on the blood pressure.

MATERIALS AND METHODS

Preparation of *Garcinia kola* enhanced diets

Garcinia kola seeds were bought from Uselu market in Benin City. The seed coat was removed and the seeds were dried in an oven at a temperature of 80°C, these seeds were weighed every 24 hours until a constant weight was obtained. The seeds were then grounded into powder.

Animal grouping and experimentation

Fifteen Wistar rats obtained from the Faculty of Science Uniben and kept under normal environmental conditions were divided into three groups A, B and C. Groups A rats had normal rat chow and water *ad libitum* while group B rats had *Garcinia kola* diet (10% w/w) made by mixing 90g of rat chow and 10g of *Garcinia kola*. Group C rats had *Garcinia kola* diet (15% w/w) made by mixing 85g of rat chow and 15g of *Garcinia kola*. Both groups had free access to tap water. Their blood pressure was monitored weekly for a period of 6 weeks with the aid of a non-invasive blood pressure measuring device (rat-tail cuff equipment).

Plant Extraction

100g of GK powder was extracted with 300ml of a 2:1 mixture of chloroform and methanol using soxhlet apparatus. At the end of extraction the extract was concentrated, and solvent was totally evaporated in a petri dish and a fine brownish powder was obtained. Different concentration of crude extract was made by dissolving a known mass of extract in 10ml of a solvent made up of 0.5ml of 70% ethanol and 9.5ml of distilled water.

Rats for this second experiment, were kept under environmental conditions and at room temperature, and were fed normal rat chow and water *ad libitum* until they attained an average of 185g of body weight.

Animal preparation

Rats were anaesthetized with thiopentone sodium (100mg/kg b.wt), blood pressure (BP) and heart rate (HR) was measured via a canula placed in the carotid artery connected through a force/pressure transducer to a measuring device (Ugo Basil Italy). Solvent alone was injected via jugular vein and BP and HR were recorded, and used as control. Different doses of extract were then injected and BP were recorded. During this experiment normal saline was periodically infused to compensate for loss of fluid.

Chemical Analysis

Phytochemical Analysis revealed that extract contains Flavonoids, Tanins, Saponins, Biflavonoids and Resins.

Statistical Analysis

Student unpaired t-test was used to compare means and $p < 0.05$ was accepted as being statistically significant.

RESULTS AND DISCUSSION

Table 1, shows changes in Systolic Pressure ($n=5$). Systolic blood pressure of treated groups reduced significantly ($p < 0.05$) in the third week. Table 2 shows effect of graded dose of extract on Blood pressure and heart rate of Wistar rats ($n = 10$). Dose range of 1 g/kg bwt produced a significant ($p < 0.05$) fall in mean arterial blood pressure and a significant ($p < 0.05$) increase in basal heart rate. Table 3 shows effect of cholinergic blockade (ACB) and Histaminergic blockade (AHB), on blood pressure reducing effect of *Garcinia kola* extract.

The blood pressure lowering effect of several plant materials have been investigated and documented, these

include blood pressure lowering effect of hibiscus Sasdaritta (Adegunlowe et al 1994) seeds of pawpaw and Garlic. The effect of these plants on blood pressure has been traced to their ability to reduce total peripheral resistance either by direct or indirect action on the vascular smooth muscle. It has been observed that Raynodine lowered mean arterial pressure and suppressed basal heart rate (Eferakeya et al 1992). However this work has revealed that *Garcinia kola* lowering mean arterial pressure but produced an increase in basal heart rate. This could be attributed to compensatory response of the heart to the fall in total

peripheral resistance as a result of extract action on vascular smooth muscle. This is further supported by the fact that in rats that ingested GK diet in experiment 1, there was an increase in systolic blood pressure towards the normal after the highest fall in the fourth week. Substances like GK that affect vascular smooth muscle could act through a second messenger such as cyclic AMP. Anderson (1993^b), presented extensive evidence that cyclic AMP stimulates an energy requiring Ca^{2+} binding mechanism that leads to a decrease in sarcoplasmic Ca^{2+} and hence relaxation.

Table 1

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Group A	122.3±5	120.8±4	123±5	122.8±5	123.1±6	121.5±5
Group B 10% w/w	123.2±5	118.4±5	104.0±4	100.5±5	102.2±4	106.8±5
Group C 15% w/w	124.0±5	106.2±4	104.5±5	96.4±5	95.4±5	100.8±5

Table 2

Dose mg/kg	Basal	Solvent	0.5	1	2.5	3
MmHg systolic	128±6	128±6	125±7	118±5	103±6	88±3
MmHg Diastolic	84±5	83±4	80.8±6	76±7	71±4	55±6
MAP MnHg	98.0±5.0	97.1±2.1	95.7±8.2	90.5±4	82.6±2.4	66.8±1.2
HR b/min	360±18.0	365.8±19	363±19	370±18.2	375±19	395±20
% Drop in MPA	-	-	3%	7%	15%	31%
% increase in Hr	-	-	-	2.4%	4.2%	9.8%

Table 3

	Control	Extract 2.5 mg/kg	Extract 2.5 mg/kg (ACB)	Extract 2.5 mg/kg (AHB)
MAP mmHg	97.1±2.1	82.6±2.4	84.0±4	92.8±5
% Drop		15%	12%	5.3%

The effect of two blockers (Atroprine and cemitidine) on the effect of extract, on mean arterial pressure, showed that both blockers suppressed the effect of extract. However cemitidine, a histaminergic blocker caused a statistically significant attenuation. These suggest that extract may be acting through cholinergic or histaminergic receptors to bring about vasodilatation and a corresponding drop in total peripheral resistance.

The effect of extract could however be as a result of direct action of extract on vascular smooth muscle. This may be via a calcium chelating mechanism as it is

know that most flavonoids are antinutrients, removing cholesterol, calcium and glutathion from the blood (Braid 1991) already it is know that the major pharmacologically active ingredient in GK is a flovonoid. Also the removal of glutathione from the blood could help the vasodilatation of resistant vessel as it has been observed that reduced glutathione level improved coronary endothelial vasomotor function by potentiating the vasodilator function of Nitroglycerine (Krishnan 1999). Membrane stabilization and reduction

of blood viscosity (Elekwa et al 2003) is another possible way by which GK may reduce blood pressure.

In conclusion, *Garcinia kola* contains a vasoactive ingredient, which is capable of lowering blood pressure. However, the mechanism of action is yet to be fully understood.

REFERENCES

- Akoachere JF, Ndip RN, Chenwi EB, et al (2002).** Antibacterial effect of *Zingiber officinale* and *Garcinia kola* on respiratory tract pathogens. East Afr Med J; 79(11): 588-592.
- Anderson R (1993^b).** Role of Cyclic AMP and Ca^{2+} in mechanical and metabolic event in isometrically contracting vascular smooth muscle Acta, physiolskad 87:84 – 95.
- Adegunloye BJ, Omoniy J.O., Owolabi O.A., Ajagbona O.P., Coka H.A.B. and Sofola O.A(1994).** Blood Pressure lowering effect of calyx extract of *Bibiscus salderitta* in rats Uig J. of Physiol. Sc 9 (1-2) pp 88.
- Braid V.B. (1999)** Inhibition of Hepatotoxicity induced by CCL4 afforded by *Garcinia kola* plasmodic effect of seed of *Garcinia kola* Phytotherapia Lx 123 – 129.
- Braid V.B. (1992)** Protection of *Garcinia kola* against castor oil induced diarrhoea phytotherapia Res vol 4, p 26.
- Stanly D.F., G and Airova B. (1979)** Mechanism of action of vasoactive agent. Natural Heart and pump institute.
- Eferekeya A.G. and Uche A.O. (1992) Effect of Raynolive on cardiovascular Responses during development of Hypertension in spontaneously hypertensive rats Nig. J. of physiol Sci 8 (1 – 2) 49 – 53.
- Elekwa I. Monanu M.O. Anosike E.O. (2003),** Effect of aqueous extract of *Garcinia kola* Seed on membrane stability of Hb AA, HbAS and HbSS human erythrocytes. Global journal of Medical Sciences, Vol. 2 No. 2
- Krishnan K. (1999)** Nitric oxide-friend or foe? Clinical application Depart of physiol, 7 – 169 calicut medical college (symposium).
- Nakajima A and Horn L Electrical activity of single vascular smooth muscle fibre (1967) Am. J. of physiol. 213 25 – 30.
- Naiho A.O. (2004)** Effect of *Garcinia kola* on reproductive organ weight and histology of Testis and anterior pituitary gland of wistar rats. J. Exp. and Clin. Anatomy Vol. 3 No. 2:20-23.
- Makander P.J. (1986),** Flavonoid affect acetylcholine, prostaglandin E2 and antigen mediated smooth muscle contraction. In plant flavonoid Bio & Med. Biochem. Pharmacol & structural-active relationships. Ed. By V. Cody, E. Middleton, J.I. Harbone. PP 489-492 Alan R Liss Inc. New York.
- Olajide O.A. (1999)** Investigation of the effect of selected medicinal plant on experimental Thrombosis. Res; 13(3): 231-2.
- Oluwole F.S. and Obafemi A.B. (1992),** The effect of *Garcinia kola* on Gastric acid secretion in Albino rats Nig. J. of Physiol Sci vol. 8 (1 – 2) p 115.
- Von Loh D. (1971)** Untersuchungen Znr Acetylcholinwirkung ant die Vena potae Des mearvschioenshens Pfluegers. Arch. 330: 90 – 98.