

Full Length Research Paper

Some effects of the administration of the combination of *Allium sativum* (Garlic) and *Citrus aurantifolia* (acid lime) on blood pressure in normotensive cats

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Allium sativum (garlic) and *Citrus aurantifolia* (acid lime) have been in use in the traditional management of hypertension without a scientific evidence of the benefit of their combination. Much of the control of blood pressure is dependent on the cardiac muscle developed force and the total peripheral resistance, an activity of the vascular smooth muscle. This study is undertaken to investigate the effects of garlic and acid lime on blood pressure changes. Garlic and lime obtained from the open market were identified and extracted in water. The extracts were administered to cats singly and later combined in graded doses, and the blood pressure was recorded. Results show that garlic reduced blood pressure with a sustained heart rate, while acid lime reduced blood pressure but with a rise in heart rate. When combined, the extracts reduced blood pressure with no change in heart rate. It is concluded that the combination of garlic and lime is beneficial in blood pressure changes, and that the combination may be acting via a reflex mechanism which might be cardio protective.

Key words: Garlic, acid lime, blood pressure, cat, heart rate, cardio, protection.

INTRODUCTION

Most agents usually influence cardiovascular control in one direction. Garlic and lime combination administered, primarily as traditional medical practice, is claimed to be safe on the heart. However, scientific proof of this benefit is not yet documented. Some local vascular effects (which may be obtained from plant products) have been reported as beneficial to cardiovascular control (Morris et al., 2001; Arcaro et al., 2001). However, the precise mechanisms of dysfunction underlying changes in vascular functions induced by blood pressure changes are yet unclear. *Allium sativum* (Liliaceae) is a well known herbaceous plant of varied applications, having been in use since ancient times for the treatment of various disease states. Egyptian Greek and Roman literature have documented its use since 1550 BC. Scientific investigations into garlic began in the 19th century (Odeh

and Ibu, 2002). Among the many effects of garlic, it is reported to lower blood pressure (Sendl, 1995). However, the blood pressure lowering mechanism has not been studied (Reuter, 1995). Lime (Rutaceae) is a rather small tree, and has been analyzed for ascorbic acid (Chopra, 1982). It is found to contain Ca^{2+} and is antitoxic to various poisons (Chopra, 1982). Acid lime (*Citrus aurantifolia*) is lower in ascorbic acid content than other citrus species, though relatively poorly studied (Chopra, 1982; Oguntona and Akinyele, 1994). Recent traditional medical treatment of blood pressure combines garlic and lime (oral communication). The scientific basis for this combination has not been studied. We therefore investigated the basis of the combination as to ascertain any possible beneficial role of the practice.

MATERIALS AND METHODS

Plant

Fresh garlic and lime were obtained from the open market, and

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Table 1. The effects of garlic, lime, and their combination on cat blood pressure at a dose of a 1.0 mg/ml.

Parameter	Garlic (1 mg/kg)	Garlic (10 mg/kg)	Garlic (100 mg/kg)	Lime (1 mg/kg)	Lime (10 mg/kg)	Lime (100 mg/kg)	Garlic + Lime (100 mg/kg)
SBP	56	72	80	84	82	73	51
DBP	35	48	61	55	52	41	26
PP	21	24	19	29	30	32	25
MAP	42	56	67	65	62	52	34

SBP: Systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; MAP: mean arterial pressure.

Table 2. The effects of Garlic, Lime, and their combination on cat blood pressure at a dose of a 2.0 mg/ml.

Parameter	Garlic (1 mg/kg)	Garlic (10 mg/kg)	Garlic (100 mg/kg)	Lime (1 mg/kg)	Lime (10 mg/kg)	Lime (100 mg/kg)	Garlic + Lime (100 mg/kg)
SBP	54	70	73	74	78	68	47
DBP	33	47	52	47	49	37	19
PP	21	23	20	27	29	31	28
MAP	42	55	59	56	59	47	28

SBP: Systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; MAP: mean arterial pressure.

authenticated by a plant taxonomist, Mr. Okonkwo, at the Federal College of Forestry, Jos, Nigeria.

The fresh garlic was sun dried to constant weight, the cloves peeled, and ground to a fine mesh. A weighed quantity of the ground component was placed in a conical flask containing deionized water. The mixture was thoroughly mixed and allowed to stand for 24 h at room temperature. The flask and its content were shaken at 6 to 8 h intervals during the 24 h period. At the end of 24 h, the mixture was filtered with a fine Whatman filter paper, and the filtrate evaporated to dryness using water bath at 40°C. The extract was weighed and stored in an air-tight container.

The lime fruits were cut into two, and the halves squeezed manually to obtain the juice. The juice was stored in an air-tight bottle.

Animals and anaesthesia

The cats were kept and fed *ad libitum* for five days before being used for experiments. The cats were weighed and anaesthetized with pentobarbitone sodium, 5 mg/kg body weight, given intraperitoneally.

After the anaesthesia, the neck was incised and dissected to expose the trachea. The trachea was intubated with a cannula (Portex; internal diameter, 0.75 mm; external diameter, 1.02 mm). The femoral vein was also cannulated, and 0.3 ml of 5000 IU/ml heparin was injected to prevent blood clotting. One of the carotid arteries was similarly cannulated and connected to a transducer (Washington P.T 400). The extracts were injected through the femoral venous cannula.

Blood pressure recording

Blood pressure was recorded on the Washington recording machine (Model 400 MD/2C). The blood pressure was allowed to normalize for 20 min after the administration of a drug, before the next agent was injected, and in cases where a particular agent altered the blood pressure. The speed of the recorder was set at 6 mm/min, and the tracing was calibrated to 1 cm: 30 mmHg.

Ethical consideration

The study was approved by the departmental research ethics review committee of the University of Jos.

RESULTS

The results are shown in Tables 1, 2, 3 and 4, and Figure 1 (recording of blood pressure following the administration of garlic only); Figure 2 (recording of blood pressure following the administration of acid lime only); and Figure 3 (recording of the blood pressure following the combined administration of garlic and lime). Figure 1 demonstrates that *A. sativum* (garlic) lowers blood pressure at the given dose of 100 mg/ml of the concentration of 1200 mg/kg body weight. An unchanged frequency of cardiac contractility is also observed. The effect of *C. aurantifolia* (acid lime) shown in Figure 2 reveals a blood pressure reduction effect, but with a gradual rise in frequency of cardiac contractility.

The dose of acid lime giving the response is 100 mg/ml (of a concentration of 1200 mg/kg body weight). Figure 3 demonstrates a reduction in blood pressure without an evidence of change in contractility.

DISCUSSION

Reuter (1995) in his review presented several studies on the effect of *A. sativum* (garlic) on blood pressure. It was reported that the garlic effect was not affected by atropine or bilateral vagotomy. Some of the documented reports associated the reduction in BP with a rise in heart rate, while others reported no change in heart rate.

Table 3. The effects of Garlic, Lime, and their combination on cat blood pressure at a dose of a 4.0 mg/ml.

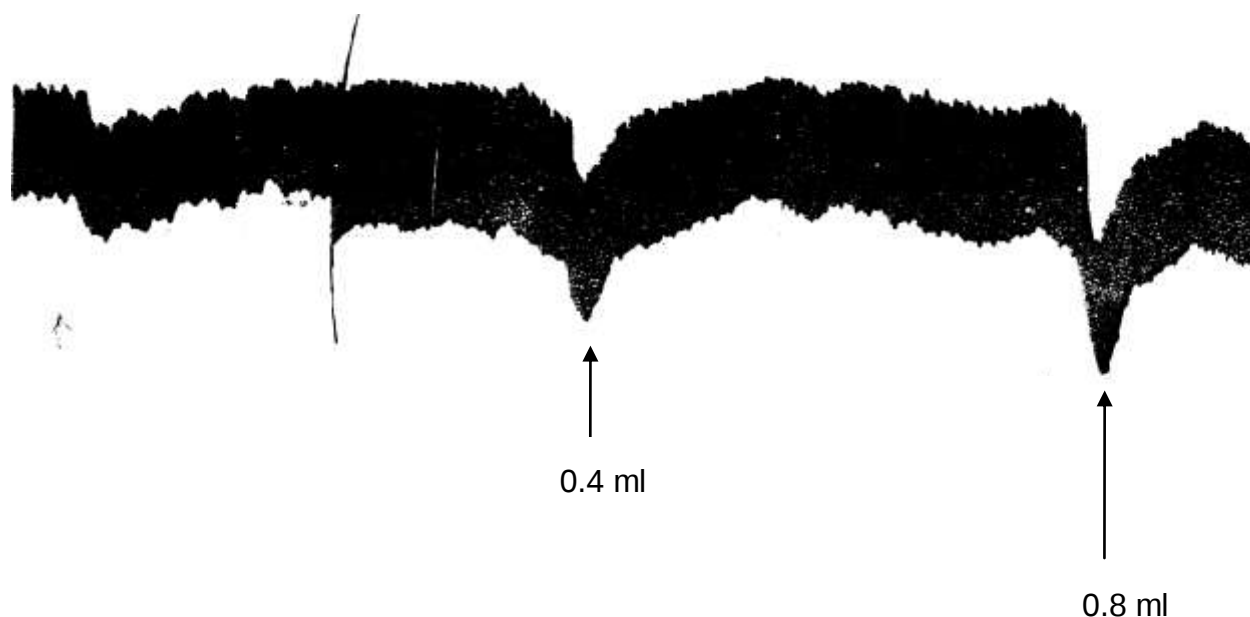
Parameter	Garlic (1 mg/kg)	Garlic (10 mg/kg)	Garlic (100 mg/kg)	Lime (1 mg/kg)	Lime (10 mg/kg)	Lime (100 mg/kg)	Garlic + Lime (100 mg/kg)
SBP	61	74	72	75	72	67	48
DBP	37	55	47	48	43	34	21
PP	24	19	25	27	29	33	26
MAP	45	74	55	57	53	45	30

SBP: Systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; MAP: mean arterial pressure.

Table 4. The effects of Garlic, Lime, and their combination on cat blood pressure at a dose of a 8.0 mg/ml.

Parameter	Garlic (1 mg/kg)	Garlic (10 mg/kg)	Garlic (100 mg/kg)	Lime (1 mg/kg)	Lime (10 mg/kg)	Lime (100 mg/kg)	Garlic + Lime (100 mg/kg)
SBP	69	77	70	70	69	0	53
DBP	39	56	47	37	40	0	27
PP	30	21	23	33	29	0	26
MAP	49	63	55	48	50	0	36

SBP: Systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; MAP: mean arterial pressure.

**Figure 1.** The effect of aqueous extract of garlic (0.4 and 0.8 ml) at 100 mg/ml on the blood pressure of normotensive cats.

In our study, garlic reduced blood pressure and heart rate was unaffected.

The effect of the garlic extract in reducing blood pressure without affecting heart rate corroborates the report of Bannerjee (1966). *C. aurantifolia* (acid lime) is not reported much on, and no study yet reported on its effect on blood pressure or the heart. The present study demonstrated a severe depressor response in blood

pressure following the administration of acid lime. This effect is dose-dependent. The heart rate was increased with the acid lime administration.

In the traditional medical management of hypertension, garlic and acid lime are concocted, and so, not following any particular fashion. It has been demonstrated that this combination of garlic and acid lime is useful as a blood pressure reducing agent. At low dose (1 mg/ml), the heart

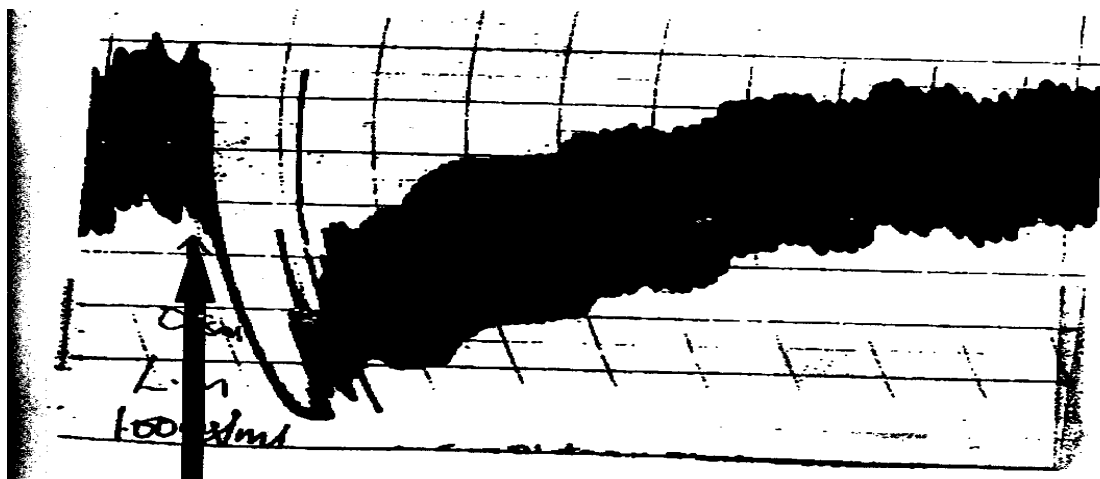


Figure 2. The effect of acid lime juice (100 mg/ml) on cat blood pressure. There is a slow recovery phase following the sharp fall in blood pressure.

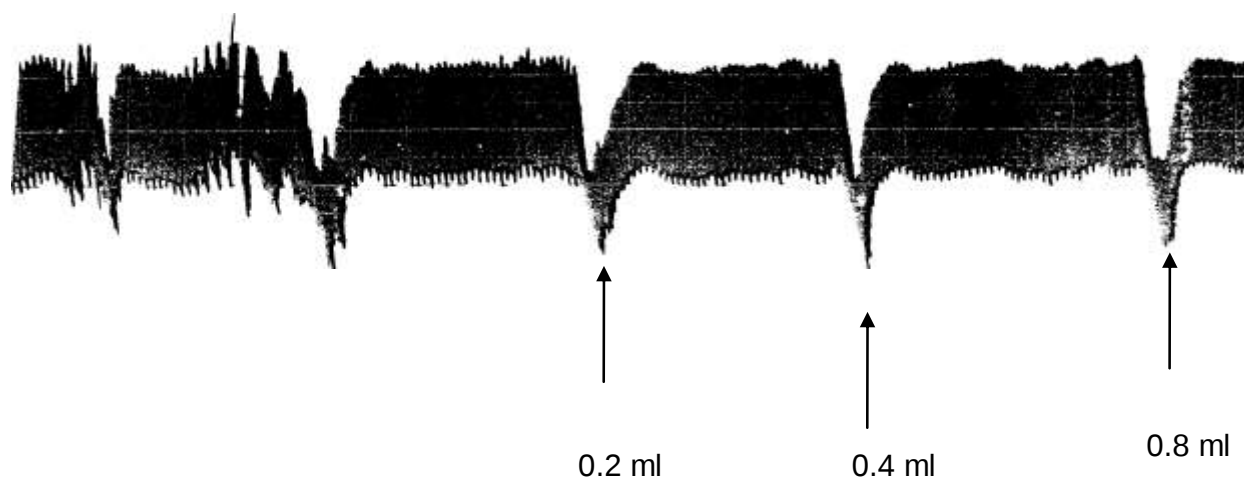


Figure 3. The effect of the combination of aqueous extract of garlic and acid lime (0.2, 0.4 and 0.8 ml) at 100 mg/ml on the blood pressure of normotensive cats.

rate pattern appears similar for garlic and acid lime. However, with increase in doses (10 and 100 mg/ml), the heart rate was raised significantly with both agents. The reduction in blood pressure does not appear to be a summated effect, and it is considered that the phenomenon is cardio protective. There appears to be a reflex mechanism in operation following the combined administration of garlic and acid lime. Garlic lowers blood pressure, an unchanged chronotropic effect in the presence of a negative inotropic response. With progress in time and effect, it is to be expected that an eventual failure in the pump ability of the heart would result. This position was demonstrated earlier by Reitz et al. (1995) who reported that the isolated heart has a reduced susceptibility to ventricular arrhythmias following treatment with garlic. This is indicative of a negative inotropic effect.

Thus, with acid lime raising heart rate while reducing blood pressure, there appears to be a protection induced against the probable inherent decompensation following the garlic response.

It is concluded that the combined administration of *A. sativum* (garlic) and *C. aurantifolia* (acid lime) is beneficial in blood pressure reduction, and that the agents acting reflexly on the chronotropic effect of the heart may be cardio protective.

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