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## Can garlic and garlic extract reduce blood perssure in dogs?

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*In this study, the hypotensive effect of garlic and garlic extract was investigated in dogs. Doses of 100, 300, 600, and 1,200 mg/kg body weight (B.W.) of garlic powder, 25 and 50 ml/kg B.W. of aqueous extract of garlic, 16, 32 and 48 mg/kg B.W. of garlic extract and 34 mg/kg B.W. of diallyl disulfide were studied in anesthetized dogs. Oral administration was via nasogastric tube. The results revealed that garlic powder, aqueous extract of garlic, garlic extract and diallyl disulfide produced slight decreases in blood pressure, heart rate and cardiac output but was statistically insignificant when compared to a control group using 0.9% NaCl. An electrocardiogram indicated a slight decrease in heart rate without any changes in rhythm and form. This study concluded that garlic and garlic extract have no effect on blood pressure in normotensive dogs.*

**Key words :** *Allium sativum Linn, Hypotensive effect, Garlic.*

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ไกรเลิศ พาสนาโสภณ, รัตรี สุดทรวง, สมพล สงวนรังศิริกุล. กระเทียมและสารสกัดกระเทียมสามารถลดความดันเลือดในสุนัขได้หรือไม่? จุฬาลงกรณ์เวชสาร 2538 เมษายน; 39(4): 283-290

ได้ศึกษาผลของกระเทียมและสารสกัดจากกระเทียมต่อความดันเลือด และอัตราการเต้นของหัวใจในสุนัข โดยใช้กระเทียมผงขนาด 100, 300, 600 และ 1,200 มิลลิกรัมต่อน้ำหนักตัว 1 กิโลกรัม กระเทียมสกัดด้วยน้ำขนาด 25 และ 50 มิลลิกรัมต่อน้ำหนักตัว 1 กิโลกรัม สารสกัดจากกระเทียมขนาด 16, 32 และ 48 มิลลิกรัมต่อน้ำหนักตัว 1 กิโลกรัม และไดอัลลิล ไดซัลไฟด์ขนาด 34 มิลลิกรัมต่อน้ำหนักตัว 1 กิโลกรัม ให้ทางสายยางเข้าไปในกระเพาะอาหารของสุนัขที่สลบ พบว่าทั้งกระเทียมผง กระเทียมสกัดด้วยน้ำ สารสกัดจากกระเทียม และไดอัลลิล ไดซัลไฟด์ ทำให้ความดันเลือด อัตราการเต้นของหัวใจ และปริมาณเลือดที่ออกจากหัวใจใน 1 นาที ลดลงเล็กน้อย แต่เมื่อเปรียบเทียบกับกลุ่มควบคุมที่ให้ 0.9% โซเดียมคลอไรด์แล้วไม่มีนัยสำคัญทางสถิติ ผลต่อคลื่นไฟฟ้าของหัวใจพบว่าอัตราการเต้นของหัวใจลดลงเล็กน้อย โดยไม่มีการเปลี่ยนแปลงของจังหวะและลักษณะของคลื่น จากผลการทดลองนี้อาจสรุปได้ว่ากระเทียมและสารสกัดจากกระเทียมไม่มีผลลดความดันเลือดในสุนัขที่มีความดันเลือดปกติ

Garlic, *Allium sativum* Linn., is widely used as a condiment and food. It has been used in folk medicine since ancient times and is still used that way in many parts of the world. The hypocholesterolemic<sup>(1)</sup> and hypoglycemic<sup>(2)</sup> properties of garlic oil extract have been well reported. The oil extract is also used in the partial treatment of diabetes<sup>(3)</sup> and in the prevention of atherosclerosis and coronary heart disease.<sup>(4,5)</sup> Loeper and Debray<sup>(6)</sup> reported the hypotensive effect of tincture of garlic in experimental animals. Aqueous extracts of garlic<sup>(7)</sup> and freeze-dried garlic<sup>(8)</sup> also produced the same effect. Oral administration of garlic powder (900 mg/day) in hypercholesterolemic patients has resulted in a decrease of blood pressure.<sup>(9)</sup> Recently, Panoja and coworkers<sup>(10)</sup> reported hypotensive effects of garlic powder in dogs and showed that high doses of garlic produce bradycardia and T-wave inversions of electrocardiograms. In contrary, Jain et al.<sup>(10)</sup> recently reported no significant change in blood pressure after giving garlic powder to hypertensive and hyperlipidemic patients. In Thailand, there was also a report about the failure of treatment the patients with essential hypertension by dried garlic.<sup>(11)</sup>

From these studies, it seems to have some controversy about the effects of garlic. The different strains of garlic may be account for variable of action. Furthermore, studies on the hypotensive effect of garlic have been undertaken mostly by using garlic powder or aqueous extracts, whereas the most active ingredient of garlic (allicin) or diallyl disulfide has been only rarely been studied for such effects. In our study, the actions of garlic powder, aqueous extract of garlic, garlic extract and diallyl disulfide on cardiovascular system of dogs was investigated. The results obtained from this study may be worth

while in supporting advanced studies of the pharmacological action of garlic.

## Material and Methods

### 1. Animal preparation

Fifty-five male mongrel dogs with body weights varying between 10-20 kg were used. The animals were intravenously anaesthetized with sodium pentobarbital at doses of 30 mg/kg B.W. Supplementary doses of the same drug were given whenever necessary to maintain the anaesthesia. The trachea was cannulated for spontaneous ventilation with room air and to facilitate respiration. Arterial blood pressure and heart rate were monitored from the right femoral artery with a pressure transducer connected to a Harvard Universal oscillograph. The cardiac output was monitored by the thermodilution method using a Criticath TM 7 F thermodilution catheter inserted into the right jugular vein, advanced to the pulmonary artery and connected to a Hemodynamic Profile Computer. The electrocardiogram (ECG) was monitored through electrodes according with a Harvard Universal oscillograph.

### 2. Garlic preparation

2.1 Garlic powder was prepared according to the method of Pantoja et al.<sup>(12)</sup> This was by drying chopped garlic bulbs in an oven at 40°C for 2 days and then they were ground in a blender. The final garlic powder weighed one third of its original weight.

2.2 Aqueous extracts of garlic were prepared according to the method of Foushee et al.,<sup>(13)</sup> by grinding fresh chopped garlic bulbs, treating with 0.9% normal saline and then filtering. The final 1 ml of aqueous extract was equivalent to 2.28 grams of fresh garlic.

2.3 Garlic extract production pro-

cedures followed those described by Poolsanong.<sup>(14)</sup> One hundred g of garlic cloves were washed and dried: After adding 120 ml of chloroform the cloves were processed in a blender until a good mixture was obtained. Then the mixture was filtered. The chloroform was separated out from the filtrate by rota vaporization at 55 °C, leaving behind a yellowish oily liquid residue. The extract was then preserved with 1.2 g of providone and stored in a refrigerator. For subsequent use, the garlic extract was diluted in normal saline solution.

### 3. Experimental procedure

The animals were divided into 5 groups as the following:-

Group 1 Garlic powder at the dosage of 100, 300, 600 and 1200 mg/kg B.W. were given. Five dogs were used for each dosage.

Group 2 Two doses of aqueous extract of garlic (25 and 50 ml/kg B.W.) were administered. Each dose required 5 animals.

Group 3 Garlic extract at doses of 16, 32 and 48 mg/kg B.W. were given. Five dogs were used in each dose.

Group 4 Diallyl disulfide (34 mg/kg B.W.) was tested in five dogs.

Group 5 Normal saline (0.5 ml/kg B.W.) was administered in five dogs for control groups.

In each group, the substances were administered orally through a polyethylene tubing inserted into stomach.

### 4. Analysis of Data

Experimental data were expressed as mean  $\pm$  S.E.M. The statistical significance was tested according to the Student's T-test for paired or unpaired variates. In multiple comparisons, the data were evaluated by analysis of variance (ANOVA).

## Results

### 1. Effects of garlic powder

Garlic powder at dosages of 100, 300, 600 and 1,200 mg/kg B.W. induced slight decreases in the systolic and diastolic blood pressure, heart rate and cardiac output, as shown in table 1. These depressions were statistically nonsignificant when compared with the same dogs before administration as well as comparing with a control group using 0.9% NaCl (table 4). An electrocardiogram also demonstrated a slight decrease in heart rate but without any changes in rhythm and form.

**Table 1.** Effect of garlic powder on blood pressure (B.P.), heart rate (H.R.) and cardiac output (C.O.)\*

Dose of garlic powder (mg/kg B.W.)	No of Dogs	Systolic B.P.(mmHg)		Diastolic B.P.(mmHg)		H.R.(beats/min)		C.O.(litres/min)	
		Before	After	Before	After	Before	After	Before	After
100	5	129 $\pm$ 11.3	121 $\pm$ 12.0	84 $\pm$ 9.0	82 $\pm$ 8.1	127 $\pm$ 17.0	110 $\pm$ 12.3	1.56 $\pm$ 0.16	1.4 $\pm$ 0.3
300	5	130 $\pm$ 14.4	126 $\pm$ 17.8	77 $\pm$ 9.9	73 $\pm$ 12.9	136 $\pm$ 9.8	126 $\pm$ 10.5	2.5 $\pm$ 0.32	2.1 $\pm$ 0.30
600	5	131 $\pm$ 9.0	121 $\pm$ 6.7	85 $\pm$ 9.0	73 $\pm$ 4.8	127 $\pm$ 12.9	113 $\pm$ 9.8	2.6 $\pm$ 0.19	2.2 $\pm$ 0.27
1200	5	138 $\pm$ 8.7	120 $\pm$ 5.7	89 $\pm$ 7.9	80 $\pm$ 8.5	146 $\pm$ 12.9	126 $\pm$ 8.4	3.1 $\pm$ 0.39	2.5 $\pm$ 0.32

\* Values are expressed as mean  $\pm$  S.E.M.

**2. Effects of aqueous extract of garlic**

Two doses of aqueous extract of garlic (25 and 50 ml/kg B.W.) were given orally. As shown in table 2, slight decreases in systolic and diastolic blood pressure, heart rate and cardiac

output occurred but this was insignificant when compared with the same dogs before administration or with the control group using 0.9% NaCl. An electrocardiogram showed normal sinus rhythm with a slight decrease in heart rate.

**Table 2.** Effect of aqueous extract of garlic on blood pressure (B.P.), heart rate (H.R.) and cardiac output (C.O.)\*

Dose of garlic powder (mg/kg B.W.)	No of Dogs	Systolic B.P.(mmHg)		Diastolic B.P.(mmHg)		H.R.(beats/min)		C.O.(litres/min)	
		Before	After	Before	After	Before	After	Before	After
25	5	121±13.2	118±9.5	72±5.8	69± 4.0	126±8.4	119±7.7	2.4±0.36	2.1±0.36
50	5	134± 9.1	128±9.8	84±4.3	66±15.3	142±7.0	135±6.3	2.4±0.16	2.0±0.26

\* Values are expressed as mean ± S.E.M.

**3. Effects of garlic extract**

As shown in table 3, the garlic extract at doses of 16, 32 and 48 mg/kg B.W. slightly decreased the systolic and diastolic blood pres-

sure, heart rate and cardiac output but without statistical significance. Normal sinus rhythm with a slight decrease in heart rate was shown by the electrocardiogram.

**Table 3.** Effect of garlic extract on blood pressure (B.P.), heart rate (H.R.) and cardiac output (C.O.)\*

Dose of garlic powder (mg/kg B.W.)	No of Dogs	Systolic B.P.(mmHg)		Diastolic B.P.(mmHg)		H.R.(beats/min)		C.O.(litres/min)	
		Before	After	Before	After	Before	After	Before	After
16	5	121± 8.7	120±6.5	89± 5.3	89±2.9	143±12.9	138±10.3	2.7±0.26	2.2±0.29
32	5	124± 5.3	120±4.7	90± 4.4	88±3.7	155± 7.1	143±13.8	2.7±0.24	2.2±0.21
48	5	135±10.3	123±9.0	94±10.8	86±9.6	127± 7.7	116± 8.4	2.6±0.30	2.3±0.31

\* Values are expressed as mean ± S.E.M.

**4. Effects of diallyl disulfide and a placebo**

Diallyl disulfide is a metabolite of allicin which is found in garlic extract. Diallyl disulfide

(Aldrich), 34 mg/kg B.W. (equivalent to 48 mg/kg B.W. garlic extract) elicited slight reductions in blood pressure, heart rate and cardiac output as shown in table 4. The slight reduction of these

parameters was also seen in animals receiving placebo (normal saline) and there was no statistical significance (Table 4). The electrocardio-

gram of both groups demonstrated a slight decrease in heart rates without any changes in rhythm and form.

**Table 4.** Effect of diallyl disulfide 34 mg/kg B.W. and normal saline 0.5 ml/kg B.W. on blood pressure (B.P.), heart rate (H.R.) and cardiac output (C.O.)\*

	No of Dogs	Systolic B.P.(mmHg)		Diastolic B.P.(mmHg)		H.R.(beats/min)		C.O.(litres/min)	
		Before	After	Before	After	Before	After	Before	After
Diallyl disulfide	5	123±3.3	120±6.4	76±2.4	70±6.1	116±5.2	114±5.6	2.6±0.19	2.5±0.29
Normal saline	5	126±1.2	120±3.5	68±6.5	68±4.7	144±12.3	139±12.2	2.5±0.08	2.2±0.15

\* Values are expressed as mean ± S.E.M.

## Discussion

The results of our study indicate that garlic powder, aqueous extracts of garlic, garlic extract and diallyl disulfide exhibit nonsignificant reductions in blood pressure, heart rate and cardiac output. The slight decrease in these parameters may be due to the anaesthetic action of the barbiturate since the placebo produced the same effects. The highest dose of garlic powder used in our study (1200 mg/kg) was 480 times higher than those used by Pantoja et al.<sup>(12)</sup> who reported gradual decreases in systolic arterial pressure by gastric administration of garlic powder (15 mg/kg B.W.) in anaesthetized dogs. Such different effects might be explained by the difference in animal strains or the content of the garlic itself. Pantoja et al.<sup>(12)</sup> also reported initial bradycardia and T-wave inversions which were not seen in our experiment except for slight bradycardia but without statistical significance.

The highest dose of aqueous extract of garlic used in our study (50 ml/kg B.W.) was 500 times higher than those used by Foushee et al.<sup>(13)</sup> They reported a decrease in blood pressure in spontaneous hypertensive rats under gastric administration of aqueous extracts of garlic. The use of normotensive animals in this study may be the reason for the difference in the effects besides the possible difference of constituents in the garlic.

Our garlic extract contained about 60% diallyl disulfide which derived from allicin, the biologically active compound in garlic.<sup>(15)</sup> The dosages used in our study i.e. 16, 32 and 40 mg/kg B.W. were equivalent to 600, 1,200 and 1,800 mg/kg B.W. of garlic powder. It was shown that both garlic extract and diallyl disulfide could not significantly reduce blood pressure. It may thus be concluded from this study that diallyl disulfide alone may not have any effect on blood pressure. The hypotensive effect of garlic in other studies

may be due to other components in the garlic such as Ajoene Vinylthiins<sup>(16)</sup> or other thiosulfonates.<sup>(17,18)</sup> Further investigations are suggested for these components.

There is a Thailand report in indicating the failure of the garlic treatment in patients with essential hypertension.<sup>(11)</sup> Dried garlic, 700 mg per day, prescribed to these patients orally for 4 weeks produced no significant change in blood pressure. Similarly, Jain et al.<sup>(10)</sup> recently reported no significant change in blood pressures after giving 900 mg/day garlic powder to hypertensive and hyperlipidemic patients for 12 weeks.

From these studies, it might be concluded that garlic grown in different places produces different effects. Furthermore, the components of the active ingredients in garlic from different places were different.<sup>(16,19,20)</sup> This could be responsible for the variable action.

### Conclusions and Suggestions

The results of our study indicate that garlic powder, aqueous extracts of garlic and garlic extract exhibited nonsignificant changes in the cardiovascular system of dogs. These results seem to conflict with some previous experiments. The difference in the effects may be due to different strains or species of animals, normotensive or hypertensive animals, and variations of the components of the active ingredients in garlic. Further investigations on the cardiovascular action of each active ingredient found in garlic and its mechanism of action are suggested.

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