EFFECT OF RED GINSENG ON HEMODYNAMIC CHANGES BY PHYSICAL EXERCISE

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INTRODUCTION

We investigated the clinical benefits of red ginseng (Ginseng radix rubura) on healthy people from the perspective of internal medicine. Large dose of red ginseng was administered to healthy subjects who were then subjected to exercise. The change in their hemodynamic parameters were measured and analyzed.

This was of interest not only in that it relates to the treatment of myocardial infarction patients but also to those suffering from ischemia and hypertension.

EXPERIMENTAL METHODS

1. Subjects

24 healthy subjects (12 male, 12 female, age 30 ± 7 years) were chosen from the employees of Matsuyama Red Cross Hospital.

2. Red Ginseng Administration

The red ginseng used was the powdered capsules produced by the Korean Office of Monopoly. Each capsule contained the equivalent of 0.3 g in Japanese pharmaceutical red ginseng (6 year old red ginseng). The powder, without the capsule, was directly administered. One administration consisted of 4.5 g (approximately 15 capsules) of red ginseng powder.

3. Exercise Loading

ML-300 Treadmill Stress Test System, made by Jukuda Electric Co., was used at 3.5 mi/hr, slope 10%, for 5 minutes per session.

The intensity of loading was chosen to give the desired heart rate of approximately 150/min through moderate to severe exercise.

4. Measurement of Hemodynamic Parameters at the Time of Exercise Loading

1) First Session

This exercise session was conducted without the administration of red ginseng. Heart rate (HR), blood pressure (BP), and ST interval was measured immediately before and after loading as well as after a 10 minute recovery period. ST interval was determined using CM5 induction.

2) Second Session

One hour after the first session, ginseng powder was administered to the test subjects. After another hour, exercise loading was carried out as in the first session and the various parameters measured in the same manner.

The two sets of data, one obtained without ginseng powder and one with ginseng powder, was analyzed to determine the effect of red ginseng on the hemodynamic parameters during cardiac stress loading on healthy subjects.

RESULTS

The period before ginseng powder administration was designated as C period, and after ginseng powder administration as G period.

1. Blood Pressure

1) Systolic Blood Pressure

Systolic blood pressure during G period was significantly lower than in the C period when measured before loading, at maximal loading, and during the recovery period (Figure 1).

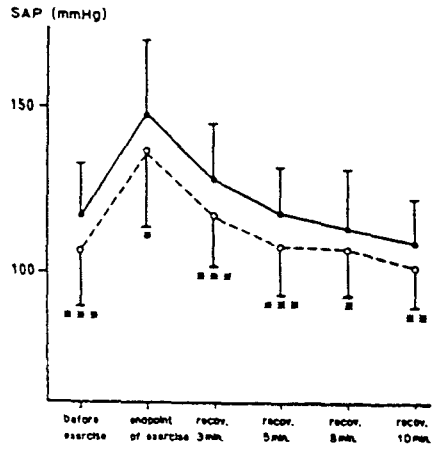


Fig. 1. The effect of red ginseng on systolic blood pressure during the experimental period.

2) Diastolic Blood Pressure

Diastolic blood pressure during the G period was found to be significantly lower than that during the C period when measured before loading, at maximal loading, and at 8 minutes after cessation of exercise (Figure 2).

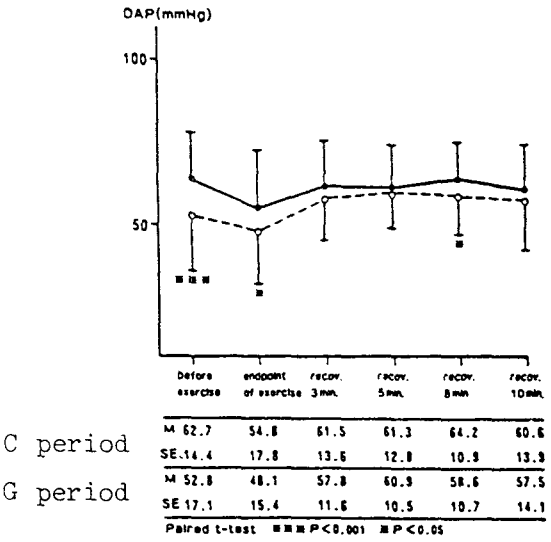


Fig. 2. The effect of red ginseng on diastolic blood pressure during the experimental period.

3) Mean Blood Pressure

The mean blood pressure during the G period was found to be significantly lower than that during the C period when measured before loading, at maximal loading, and at 3 and 8 minutes into the recovery period (Figure 3).

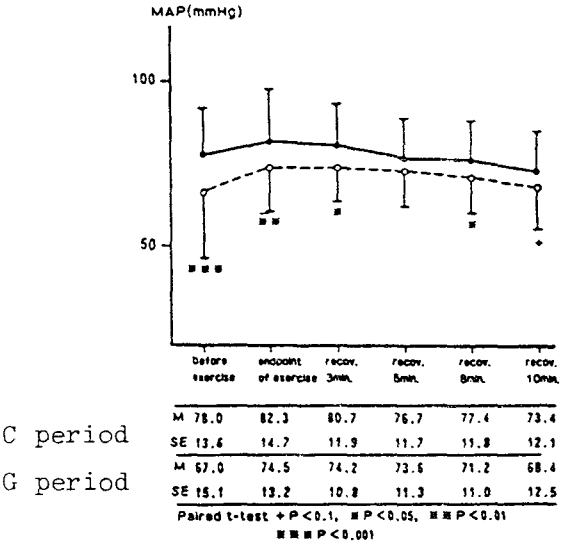
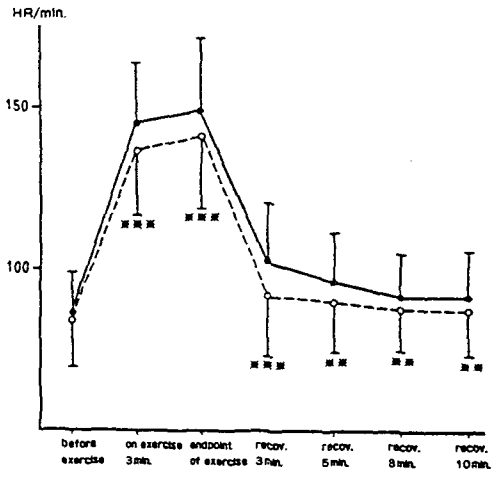


Fig. 3. The effect of red ginseng on the mean blood pressure during the experimental period.

2. Heart Rate

The difference in resting heart rate during G and C periods was not statistically significant.

However, the heart rate measured during G period, at 3 minutes into loading, at maximal loading, and at 3, 5, 8, and 10 minutes into the recovery period was significantly lower than that during the C period (Figure 4).



C period	M 86	145	149	102	96	92	92
	SE 12	19	22	18	15	13	14
G period	M 86	137	141	92	90	88	88
	SE 16	20	22	19	16	14	14

Paired t-test ＊＊P<0.01, ＊＊＊P<0.001

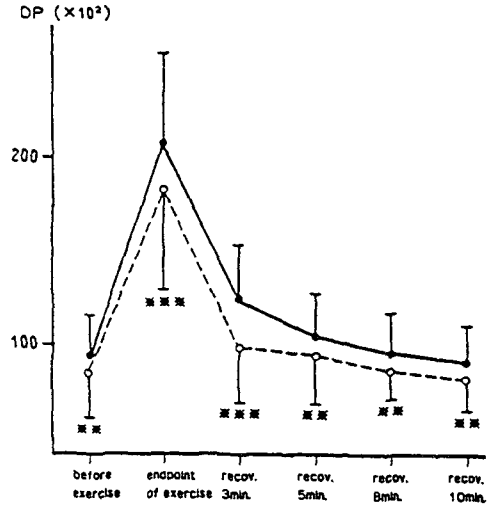
Fig. 4. The effect of red ginseng on exercise-induced change in heart rate.

3. Double Product

The double product obtained during the G period, from before and after loading as well as throughout the recovery period, was significantly lower than that obtained during the C period (Figure 5).

4. ST Inverval

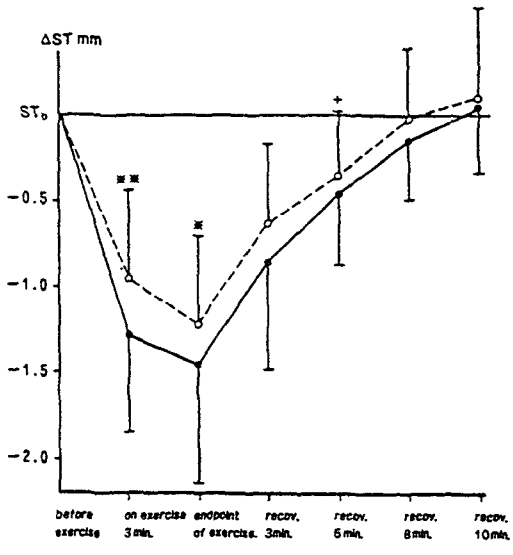
The decrease in ST interval during G and C periods, caused by exercise, was compared using resting ST interval as 0. It was found that at 3 minutes after the beginning of exercise and at maximal loading, the decrease in ST interval was significantly smaller in the G period than in the C period (Figure 6).



C period	M 93.2	208.7	122.0	103.1	95.7	91.1
	SE 21.8	30.3	30.3	23.5	19.9	17.6
G period	M 83.4	181.6	99.1	93.9	85.6	80.5
	SE 23.3	50.3	25.2	28.5	16.7	18.3

Paired t-test ＊＊P<0.01, ＊＊＊P<0.001

Fig. 5. The effect of red ginseng on double product during the experimental period.



C period	M	−1.30	−1.44	−0.85	−0.48	−0.15	0.08
	SE	0.54	0.69	0.64	0.41	0.34	0.37
G period	M	−0.95	−1.21	−0.73	−0.35	−0.03	0.10
	SE	0.49	0.51	0.47	0.37	0.40	0.51

Paired t-test +<0.1, ＊P<0.05, ＊＊P<0.01

Fig. 6. The effect of red ginseng on changes in the ST interval during the trial period.

DISCUSSION

Exercise increases the sympathetic nervous system activity and the total oxygen consumption. This causes the stroke volume to increase to compensate for the increased activity. As coronary oxygen demand increases beyond its supply, insufficient blood to the heart results,

which appears clinically as exercise-induced ischemia, and technically as a shortened ST interval in an ECG.

As a result, excessive sympathetic nervous system activity is countered, and the heart rate decreases with a following decrease in the blood pressure. This reduction of the workload on the heart as well as the dilation of the coronary vessels result in the restoration of adequate coronary oxygen supply. This, in turn, alleviates the ischemia and normalizes the ST interval.

In our previous studies, we had administered large dose of red ginseng to healthy subjects and observed the hemodynamic responses under static conditions.[2,3] Our results indicated that red ginseng dilates the peripheral blood vessels and this then decreases the after load. At the same time, venous blood flow increased and thereby slightly increased the pre-load as well. Consequently, stroke volume and cardiac output increased. Therefore, in addition to increasing cardiac output, cardiac workload decreased with a resulting savings in myocardial oxygen consumption.

In our current experiments, we proceeded to explore the effects of red ginseng on various hemodynamic parameter changes under dynamic conditions (Figure 7).

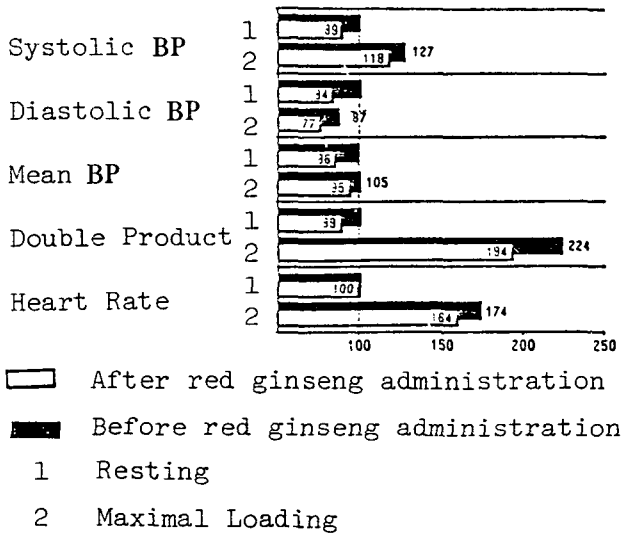


Fig. 7. Changes in various hemodynamic parameters before and after treadmill exercise loading (100 represents the resting state before ginseng administration).

Figure 7 shows the difference in various parameters measured at maximal loading during G and C periods (5 minutes after beginning of exercise).

During exercise, systolic blood pressure increased, diastolic blood pressure decreased, and resulted in an overall increase in blood pressure. This increases the overall cardiac activity but red ginseng was found to oppose this increase in activity.

Heart rate during resting period showed no observable difference. During exercise, however, the red ginseng administration definitely decreased the exercise-induced increase in heart rate and this synergistic effect shows up clearly in the double product.

That red ginseng decreases blood pressure has been stated by us and other investigators. This is believed to result from peripheral vessel dilation. Lee[5] has suggested that Ca^{++} plays the antagonistic role in this mechanism and we share this view.

Currently, we are investigating the effect of red ginseng on platelet coagulation and have established that ginsenoside Rg_1 blocks the activity of Ca^{++} inophore (A23187).[6] This is of particular interest because red ginseng achieves this effect not only through affecting transmembrane transport of Ca^{++} but possibly also through altering the intracellular movement of Ca^{++}.

Additionally, it has been reported that another component of ginseng, namely adenosine, is effective in dilating coronary vessels.[7] Alhough it has not been determined whether this is due to generalized relaxation of vascular smooth muscle, it is one possible interesting mechanism of action.

Propranolol and related compounds are known to oppose increase in heart rate during exercise. This is believed to be the result of the β-blocking activity of propranolol which moderates the reflex increase in sympathetic activity.

Red ginseng administration shows much the same effect as these compounds during and after exercise. Heart rate during the G period was significantly lower than that during the C period and this mimics the effect of a β-blocker.

Previously, Kim has stated that ginsenoside Re has an adenosine-receptor blocking activity. But it is not clear whether our results, obtained using total saponin, contradict this hypothesis or not.

Figure 8 shows the relationship between ST interval and the double product at the point of maximal exercise loading during the G and C periods. The ST interval promotion (ΔST-dmm) from red ginseng administration is plotted on the x-axis and the change in double product (%) due to red ginseng administration is plotted on the Y axis. The correlation coeffiecient of r = 0.641 ($P < 0.001$) is statistically significant. These two parameters show an inverse relationship.

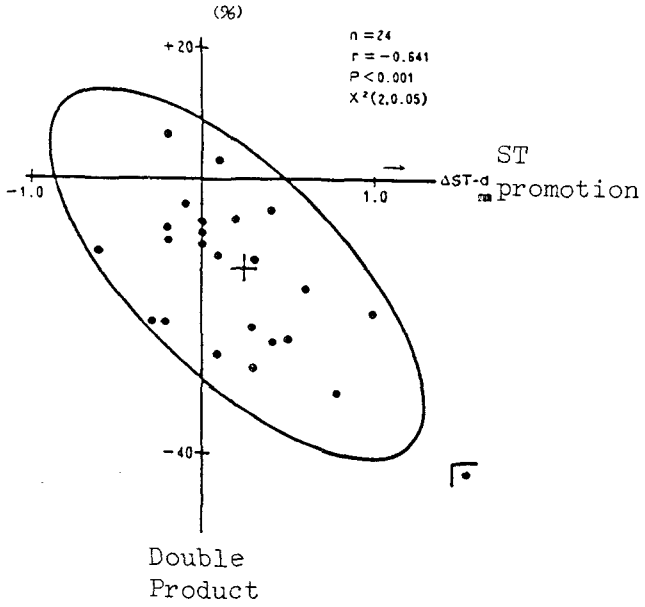


Fig. 8. The correlation between ST* promotion and changes in double product due to red ginseng administration at maximal loading before red ginseng administration (C period). The line represents the 95% confidence ellipse.
* ΔST-d. . . A drawing of ST decrease (ΔSTmm) before red ginseng administration and ST increase after red ginseng administration obtained during the period of maximal exercise loading.

Further investigation into not only the decrease in oxygen consumption during ST promotion, but also into oxygen supply from coronary circulation needs to be done. It is possible that the aforementionned adenosine, as well as the extension of diastolic period as the result of decreased heart rate, may play a beneficial role.

Whether we can apply these results, obtained from healthy subjects, to patients with hypertension or cardiac ischemia, should be urgently investigated.

CONCLUSION

Large dose of red ginseng powder (4.5g) was orally administered to 24 healthy subjects (12 male, 12 female). An exercise loading test using a treadmill was conducted before and after red ginseng administratio in order to evaluate its effect on some of the hemodynamic parameters at the time of exercise loading.

The advanced administration of red ginseng powder, when compared to the control period, inhibited the increase in the reflex blood pressure and the heart rate at the time of exercise loading.

Myocardial oxygen consumption became more efficient and decreased somewhat. Shortening of the ST interval was prevented to some degree during exercise loading.

Therefore, it can be inferred that red ginseng opposes excessive reflex action of the sympathetic nervous system during exercise and has a favorable effect on myocardial metabolism and coronary circulation.

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