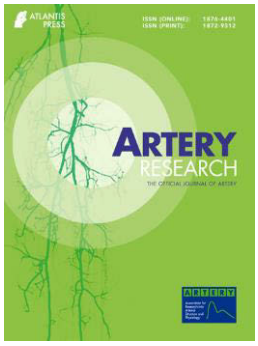

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The effect of ginseng supplement on heart rate, systolic and diastolic blood pressure to resistance training in trained males

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KEYWORDS
Panax;
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Abstract *Objectives:* Ginseng Panax has been used for centuries in Chinese medicine as source of health and stamina. We want to examine the affect of ginseng supplement on heart rate, systolic; blood pressure and diastolic blood pressure in trained athletes at rest, during and after resistance; training.
Methods: Twenty four athletes entered this protocol. Subjects (age 23.96 ± 1.82; weight 84.5 ± 9.86; height 175.37 ± 5.36) divided randomly in 2 groups: ginseng group (n = 12) and placebo group (n = 12). Each of them received 2 capsules of ginseng for 4 weeks. Before intervention, heart rate, systolic and diastolic Blood Pressure at rest, immediately after exercise, 15, 30, 45, and; 60 min after exercise were measured. They performed training program while taking; ginseng for 4 weeks and again heart rate, systolic and diastolic blood pressure measurement at; those time points which was mentioned above were taken.
Results: The analysis of SPSS showed that heart rate and diastolic blood pressure in ginseng; group only at time test were significantly different from placebo group and systolic blood pressure at rest time, test time and 60-minute after exercise increased significantly differ between ginseng and placebo group ($p \leq 0.05$) and other time points exception of these times that mentioned above were not significantly different ($P > 0.05$).
Conclusions: We conclude that ginseng complement help improve blood circulation during exercise, it decreases peripheral vascular resistance, and help oxygen delivery to actively

Abbreviations: SBP, systolic blood pressure; DBP, diastolic blood pressure; TRE, time rest; TTE, time test; T15, 15 minutes; T30, 30 minutes; T45, 45 min; T60, 60 min after exercise; HR, heart rate.

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contracting muscles. Also, it may influence recovery blood pressure after lifting heavy weight.

Introduction

Ginseng (Genus Panax) root has been a popular Chinese medicine that has been consumed as a natural ergogenic aid in many countries by athletes. It's been shown that ginseng can help to improve overall health. The active parts of ginseng are tnterponoid glycosides or saponins, termed ginsenosides.[1] According to previous studies ginseng has antioxidants effect, and may modulate corticotropin and cortisol production, immune system neuroendocrine activity, and carbohydrate and lipid metabolism, and stimulates nitric oxidation production in cardiovascular system.[2]

Some studies have reviewed ginseng effects on cardiovascular system. Animal studies suggest that ginsenosides may have biphasic actions on blood pressure, at the beginning of activity BP decreases and then increases.[3] Lei and Chiou (1986) found the extracts of *Panax notoginseng* decreased systemic blood pressure in rats and rabbits.[4] Many in vivo studies have suggested that ginseng may reduce BP in a dose-independent manner.[5]

Previous studies searched the effects of ginseng supplement on performance improvement during endurance exercises in athletes. Engels et al. (2001) showed ginseng couldn't show any differences between groups (19 active females with consuming Panax ginseng CA Mayer vs. parallel group design) in power during 30-second Wingate test or heart rate response.[6] After that Liang et al. (2005) found that ginseng treatment associated with a reduction in blood pressure and VO2 during exercise.[7]The American College of Sports Medicine (ACSM) recommended that resistance training has health-related benefits for all of People.

The past studies explored the effect of ginseng in athletes, while performing aerobic protocol exercises. There is little evidence that shows blood pressure-lowering affect in athletes who use ginseng complement with resistance training. On the other side, the affect of ginseng supplement on heart parameters such as HR and BP in strength training has not been studied among trained athlete. Human studies have not achieved consistent results in this field. So, we want to know the benefit of this plant on cardiovascular system after resistance exercises. The objective of this study was to study ginseng effectiveness in athletes who take part in resistance training.

Subjects and methods

Subjects

24 Healthy male athletes between the ages of 21 and 26 who have at least 2 months of resistance training experience were recruited for the study. The inclusion criteria of the participants were having good general health, no smoking, no use of sport supplement and age range of 18−27 years old. Individuals with hypertension, asthma, diabetes, bronchitis, anemia, cardiac problems, kidney or liver diseases or any other major diseases, on with body mass index $\geq$24 kg/m2 were excluded from the study. Figure 1 shows the Consolidated Standards of Reporting Trials flow diagram.

All participants read and signed an informed consent form after being informed of the testing and training procedures that would be performed during the study. Subjects were randomly divided in to 2 groups. Group1 ($n = 12$) received ginseng capsule, another group ($n = 12$) received placebo. All participants self-reported that they were not taking any medication or herbal supplements. There were no significant differences ($p > 0.05$) between groups in height, age, or weight before intervention (Table 1). The subjects were asked to avoid caffeine consumption and not to change their usual diet before during each trial.

Ginseng supplement

Each subject took either two ginseng or placebo capsules (200 mg/day) daily for 30 days. Previous studies examined different dosage of ginseng in different duration of treatment. Liang et al. examined the effectiveness of 1350 mg Chinese ginseng in 30 days and found that ginseng led to reduction in blood pressure during exercise in 29 active males and females.[7] McNaughton found significantly improved in recovery heart rate and oxygen uptake in runners who consumed ginseng 200 mg/day for 6 weeks.[8] Like authors such as Engle and Hsu et al., we used 400 mg/day in 4 weeks ginseng supplement. Each ginseng capsule contained: standardized Ginko biloba, extract GK501 (60 mg) adjusted to 24% ginko-flavone- glycosides, standardized Panax ginseng C.A.Meyer extract G115 (100 mg) adjusted to 4% ginsenosides, Excip. Pro caps.gelatin. Both Placebo capsules and ginseng capsules were produced by the same factory. Placebo capsules looked similar to ginseng capsule and has all ginseng capsule ingredients except Panax ginseng C.A.Meyer extract G115. Subjects were instructed to take two capsules after eating breakfast with one glass of water and not changing their regular diet during treatment period. They were asked to recall if they had any digestive problems during one month.

Testing procedures

In the introductory session, subjects were informed about the study in general. Anthropometrics measurements were assessed only at baseline (Table 1). Body weight was measured without shoes or outerwear within precision of 0.1 kg.

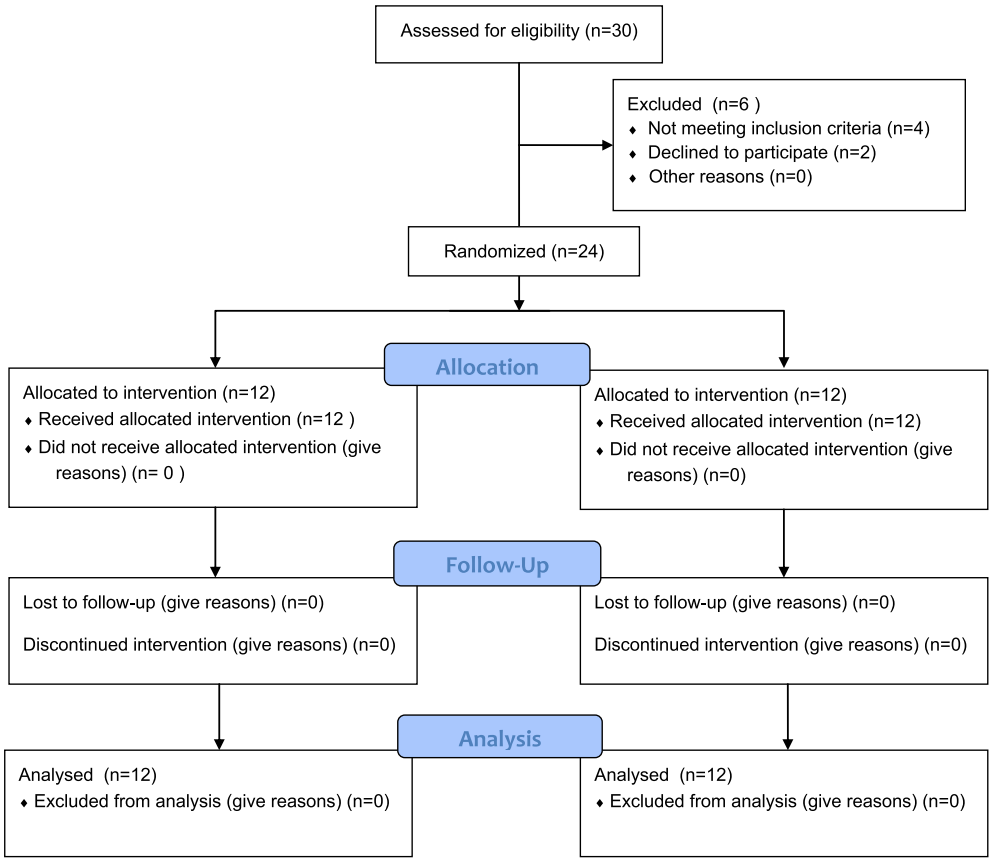

Figure 1 CONSORT flow diagram.

Blood pressure (BP) and heart rate (HR) was measured by using a digital device (25Beurer BM 60 model) which was fixed on the left arm of subjects. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) and HR measurement were taken while the participants were seated with their right arm at heart level. In the test session, SBP and DBP and HR were taken at the following time points: at rest (TRE), at training test (TTE), 15 min after test (T15), 30 min after test (T30), 45 min after test (T45), 60 min after test (T60).

At the beginning of study SBP and DBP were measured at: TRE, TTE, T15, T30, T45, and T60. Each participant was sitting in the entire protocol (60 min after test).

Subjects took two capsules each day for 30 days. After finishing one month; SBP and DBP were measured in those time points that mentioned before. During one month subjects performed resistance training program in gym. One repetition maximum (1RM) for leg press, bench press, seated row, leg curl, arm extension (triceps press) and arm curl (barbell curl) exercises were obtained.

Table 1 Baseline anthropometric characteristics.

Group	GIN (n = 12)	PLA (n = 12)
Age (yr)	23.92 ± 1.975	24 ± 1.758
Height (cm)	174.83 ± 6.118	175.92 ± 4.699
Weight (kg)	84 ± 11.449	85.00 ± 8.485

Data are mean ± SD.

Resistance training program

Subjects trained three days per week on every often day for 4 weeks. Weekly program was designed to upper -body and lower-body exercises: 5 set in 7 repetitions with 65% 1RM in bench press, arm included leg press, bench press, leg curl, triceps push down exercises on Saturday; 4 set in 7 repetition with 70% 1RM repetitions in leg extension, dumbbell arm curl, dumbbell triceps, seat row exercises on Monday; 4 set in 6 repetitions with 70% 1RM bench press, arm curl, lat pull down on Wednesday. The resistance training program each session lasted 35 min. Rest interval between sets was 2 min.

Before taking ginseng capsules, the subjects performed the pre-test, which consisted of a warm-up set consisting of eight repetitions with 50% of the load used in the protocol in the leg press, bench press and seated row exercises. Then, three sets from eight repetitions were performed for each exercise. The loads used in the leg press, bench press, seated row and leg curl exercises in the first; second, third sets were 80%, 70% and 60% of 1RM, respectively. In arm extension (triceps press) and arm curl (barbell curl) exercises, the loads used in the first, second, third sets were 70%, 60% and 50% of 1RM, respectively. After pre-test, they trained training program and took ginseng capsules concurrently for 30 days. They performed post-test the same way like pre-test protocol.

The study protocol was approved by the Ethics Committee of University of Isfahan.

Statistical analyses

To discover differences in SBP, DBP, HR values among and within the two treatment groups, we used two-way analyses of variance (ANOVA) with repeated measures, by using the statistical program SPSS (version 16.0). A scheffe's post hoc test was used to determine any significant difference. The alpha level was set at 0.05 for all statistical analyses. All data are presented as mean ± SD.

Results

The results are presented in Table 2 and the scores of P-value are shown in Table 3. We divided the results in to 3 categories:

Effect of ginseng supplement on heart rate (HR)

As we see in Table 2, there was significant difference ($P \leq 0.05$) within a group in all variables. HR in ginseng group only at TTE was significantly different from placebo group. Ginseng supplement did not have an effect on other variable: TRE, T15, T30, T45, T60 ($P > 0.05$).

Effect of ginseng supplement on systolic blood pressure (SBP)

In the duration of intervention and resistance training SBP at TRE, TTE and T60 was significantly increased between two groups (ginseng vs. placebo) ($P \leq 0.05$). SBP at 15, 30 and 45 min after exercise were not significantly affected with ginseng supplementation ($P > 0.05$).

Table 3 The score of P-value HR,SBP, DBP in different time of protocol.

P-value	HR rest	HR test	HR15	HR30	HR45	HR60
P within	0.01	0.02	0.0	0.02	0.003	0.001
P between	0.81	0.04	0.79	0.69	0.54	0.99
P-value	SBP rest	SBP test	SBP 15	SBP 30	SBP 45	SBP 60
P within	0.00	0.00	0.03	0.003	0.017	0.004
P between	0.001	0.04	0.50	0.10	0.79	0.001
P-value	DBP rest	DBP test	DBP 15	DBP 30	DBP 45	DBP 60
P within	0.28	0.04	0.018	0.001	0.38	0.67
P between	0.26	0.02	0.18	0.94	0.75	0.38

Effect of ginseng supplement on diastolic blood pressure (DBP)

Like HR, DBP in ginseng group only at TTE was significantly different from placebo group. In this study no significant difference was observed at TRE, T15, T30, T45, and T60 between groups on DBP.

Discussion

The main finding of this study suggests that HR and DBP only at time test (TTE), and SBP at time rest (TRE), time test (TTE), and 60 min after training (T60) were significantly different from placebo group.

P. ginseng had long been used as an ergogenic herb for its helpful psycho physiological effects which help to improve the endurance capacity, strength, neural functions, immune system and psychological features without any harmful effects on body.[9]

In contrast to our result, Engles et al., in 2001 and 2003 examined the effect of G115 Chinese/Korean ginseng with dose of 400 mg/d for 8 weeks on their subjects and showed

Table 2 Heart rate (HR), Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) responses to protocol different times before and after consuming ginseng supplement for 4 weeks.

Scale		HR (BPM)		SBP (mm Hg)		DBP (mm Hg)	
		Before	After	Before	After	Before	After
TRE	Gin	69.33 ± 7.16	65.25 ± 7.2	123.83 ± 10.95	110.50 ± 3.87*	78.75 ± 3.1	80.42 ± 1.44
	Pla	68.83 ± 6.96	67.08 ± 7.21	117 ± 4.13	135.58 ± 9.19	80.58 ± 2.19	80.58 ± 2.19
TTE	Gin	131.83 ± 14.71	136.92 ± 13.24*	143.5 ± 7.3	135 ± 5.81*	84.75 ± 4.35	86.67 ± 2.46*
	Pla	139.17 ± 12.86	152.08 ± 13.89	146.33 ± 6.73	143.33 ± 6.67	88.42 ± 1.88	88.33 ± 2.01
T15	Gin	97.92 ± 8.14	90.67 ± 6.76	130.58 ± 8.81	120.58 ± 7.35	80.58 ± 2.15	83.33 ± 3.25
	Pla	94.58 ± 7.75	92.42 ± 7.25	128.83 ± 8.52	126.5 ± 9.44	80.5 ± 2.23	80.83 ± 2.51
T30	Gin	81.75 ± 10.18	77.33 ± 8.78	125.42 ± 9.64	116.58 ± 4.07	83.67 ± 3.82	79 ± 1.95
	Pla	79.08 ± 8.75	77.08 ± 8.03	125.83 ± 6.33	124.5 ± 5.24	81.67 ± 3.89	81.17 ± 3.51
T45	Gin	79.92 ± 9.48	72.08 ± 8.52	121 ± 6.16	116.92 ± 4.83	79.17 ± 3.29	80 ± 2.13
	Pla	75.17 ± 8.99	72.5 ± 8.54	118.92 ± 7.11	117.67 ± 7.4	79.42 ± 3.17	79.17 ± 1.94
T60	Gin	75.75 ± 10.53	66.42 ± 7.46	119 ± 5.72	113.75 ± 4.59*	79.58 ± 2.57	79.58 ± 1.44
	Pla	72.25 ± 10.68	69.83 ± 10.03	110.42 ± 3.87	109 ± 3.9	79.17 ± 1.94	78.75 ± 2.26

GIN: ginseng; PLA: placebo. BPM: beats Per Minutes. TRE: at rest; TTE: at test; T15-T60: period after the protocol up to 60 minutes. Values are expressed as mean ± SD.

* demonstrates significantly difference between two groups ($P \leq 0.05$).

that there is no different between groups in heart rate response during cycling test.

In support from out results, one study reported that ginsenosides reduced the mean blood pressure in rats.[10] Wood et al. (1964) have reported that ginseng effect on blood pressure is produced at the vascular level.[11] Pieralisi et al. (1991) demonstrated that a treadmill and maximal receiving ginseng for six weeks. The total workload on oxygen consumption during exercise was significantly greater following ginseng preparation than after placebo treatment. At the same work load, oxygen consumption, plasma lactate levels, ventilation, carbon dioxide production, and heart rate during exercise were significantly lower after the ginseng preparation than after the placebo.[12]

Heart rate increases acutely immediately following a work-out and is affected by the amount of resistance, the number of repetitions and the muscle mass involved in the contraction small vs. large mass exercises. Heart rate recovery high (HRR) or the rate at which heart rate declines from either maximal or sub maximal exercise to resting levels is identified as a powerful and independent predictor of cardiovascular and all-cause.[13]

According to our result in Table 2, heart rate; in TRE has small change in placebo from 68 to 67 bpm, compared with ginseng from 69 to 65 bpm. However, heart rate in TTE has small change in gin from 131 to 136 bpm compared with placebo from 139 to 152 bpm. Only in T60 there is significant in heart rate from 75 to 66 bpm in gin, compared with placebo from 72 to 69 bpm.

In systolic Blood pressure; in TTE, there are large differences in gin group from 143 to 135 mmHg compared with 146 to 143 mm Hg in placebo group. In T15There is a large difference in gin group compared with placebo group.

In diastolic blood pressure; there is small differences in gin group from 84 to 86 bpm compared with placebo group from 88 to 88 bpm in TTE. There are insignificant changes in T60 in gin group.

In TTE, decrease in blood pressure leads to decrease in end-diastolic volume that finally cause to decrease in stroke volume (SV). According to equation $Q = SV \times HR$, slight increase in heart rate offsets the decrease in stroke volume at the time of testing. So, this balance leads to an increase in cardiac output (Q) that according to Fick principle increase in cardiac output accomplish with increasing in VO_2.

Resistance training is known as weight or strength training which cause both in muscle and cardiac muscles, an increase muscular strength, decreases fat percents of body.[14] In one study, researchers reported that lactic acid metabolism decreases by consumption of 4% ginsenoside in athletes who performed intense exercise.[15]

Some studies demonstrate that regular resistance training can be an important instrument in blood pressure (BP) control, both for normotensive and hypertensive individuals.[16] In the Wiley et al. study, the subjects performing the first protocol experienced a significant reduction in resting systolic pressure (−12.5 mm Hg) and diastolic pressure (−14.9 mm Hg) The resting systolic and diastolic pressures, which had decreased 9.5 and 8.9 mm Hg, respectively, returned gradually to pretraining levels after 5 weeks of detraining.[17]

In our study, reduction in blood pressure may be attributed to amount of intensity of the exercises that has been performed. The amount of intensity in resistance training is higher in comparison of aerobic performance. In higher intensity, at first blood pressure start to increase in order to provide oxygen needs for active muscles, then based on negative feedback effect, gradually BP decreases to plateau state.

Contingency mechanisms of BP reduction by ginseng may be stimulated by nitric oxide (NO). Many reports describe transient vasodilator actions, in some cases followed by vasoconstriction and increase in blood pressure. Consistently with this nitric oxide-linked mechanism, several recent studies have suggested that the antioxidant and organ-protective actions of ginseng, including cardiovascular protection, are related to increased nitric oxide synthesis.[18] It is a non-specific central nervous system stimulant, Panax ginseng may theoretically increase the effects and the side effects (increased heart rate and blood pressure) of prescription and non-prescription drugs that also stimulate the central nervous system.[3] Ginsenosides enhanced the release of NO from endothelial cells. NO plays an important role in the control of vascular tone.[19] A number of studies reported that release of local substances [potassium (K +), NO, prostaglandins, adenosine, ATP], which are effective for peripheral vasodilatation and/or the reduction of blood volume, may be the mechanisms responsible for post-exercise hypotension (PEH). It is thought that PEH is due to reductions in peripheral vascular resistance (Pescatello et al., 2004). Exercise training provokes changes in vasodilator capacity Martin et al., (1991) and the regulation of arterial pressure (Raven & Pawelezyk, 1993) which may influence recovery blood pressure.[20]

Mechanism that attributed to erogeneity of ginseng on physical performance, theories include stimulation of the hypothalamic-pituitary-adrenal cortex axis and increased resistance to the stress of exercise, enhanced myocardial metabolism, increased hemoglobin levels, vasodilatation, and improved mitochondrial metabolism in the muscle.[2]

Conclusion

Ginseng supplement has significant effect on the heart parameters such as HR and DBP during exercises, SBP at rest and exercises. It means that ginseng helps increase heart rate and blood pressure during exercise and also increases the cardiac output and blood circulations and therefore increases oxygen delivery to active muscles. Consuming ginseng is useful for athletes who participate in competitive sports that require strength in order to perform quick exercises without fatigue.

Limitation

The subjects of nutrition cannot completely be controlled. And the time between meals to test might be different in athletes.

Psychological factors can affect an athlete's performance during test this may prevent from applying all of their abilities.

Conflict of interest

The authors have no conflict of interest.

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