

# Ginseng Supplementation Does Not Enhance Healthy Young Adults' Peak Aerobic Exercise Performance

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**Key words:** ginseng,  $VO_{2max}$ , aerobic, performance, supplement, ergogenic aid

**Objective:** To determine the short term effects (21 days) of 200 mg (7% standardized) Panax ginseng supplementation vs. placebo on peak aerobic exercise performance in healthy young adults, with unrestricted diets.

**Methods:** Twenty men and eight women (age=23.2±3.2 years, height=175.8±8.6 cm; weight=75.2±15.3 kg) were randomly assigned to either a Panax ginseng or placebo group for a period of 3 weeks in a double blind design. Prior to and following treatment the subjects performed a symptom limited graded exercise test on a Schwinn Airdyne ergometer. The data were analyzed using an analysis of variance.

**Results:** No significant treatment effect was observed for the dependent variables of  $VO_2$ , exercise time, workload, plasma lactate and hematocrit at peak levels, or for heart rate and rate of perceived exertion at 150 watts, 200 watts and peak.

**Conclusions:** The results of this study do not support an ergogenic effect on peak aerobic exercise performance following a 3-week supplementation period of 200 mg 7% Panax ginseng in healthy young adults with moderate exercise capacities and unrestricted diets.

## INTRODUCTION

Ginseng is regarded as a natural ergogenic aid, and is reportedly used by approximately 5 to 6 million Americans. It is the root of the Araliaceae plant of which Panax (Chinese or Korean) ginseng is the most popular species. The term ginseng is generally considered to mean the dried root of this herb. Other species of ginseng exist including, Panax japonicus (Japanese ginseng) and Panax quinquefolius (American ginseng) [1]. Panax ginseng contains more than 20 structurally related triterpenoid glycosides called saponins, ginsenosides [2], panaxosides, or panaxilins [3]. In addition 100 g of ginseng root contains 1414J (338 kcal), 12.2 g of protein, 70 g of carbohydrates, vitamins A (retinol), B<sub>1</sub> (thiamin), B<sub>2</sub> (riboflavin), B<sub>12</sub> (cyanocobalamin), C (ascorbic acid), E (tocopherol), niacin, calcium, iron, and phosphorus, along with other trace elements [4].

Panax (Chinese or Korean) ginseng is often proposed to increase maximal exercise capacity ( $VO_{2peak}$ ) and enhance performance [5–7]. In contrast, other research has failed to find

an ergogenic effect following ginseng supplementation [10–11]. The absence of compelling research demonstrating the ability of ginseng to consistently enhance physical performance in humans may be due to the variability in the quality of the supplement [1] and/or different methods of study. Interestingly, there is a lack of information regarding the effects of ginseng supplementation on young healthy adults. Such research is necessary given that much of the ginseng advertising campaign is directed at this demographic group. In fact, approximately 40% of the 5 to 6 million Americans who are currently taking this supplement would be considered healthy young adults.

Therefore, the purpose of this study was to determine the short term effects (21 days) of 200 mg (7% standardized) Panax ginseng supplementation vs. placebo on peak aerobic exercise performance in healthy young adults. The specific aims were to determine the short term effects of ginseng on  $VO_{2peak}$ , total exercise time (T), and work load (Wk), heart rate (HR), ratings of perceived exertion (RPE), plasma lactate, and hematocrit during a symptom limited graded exercise test (SL-GXT).

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## MATERIALS AND METHODS

### Participants

Twenty men and eight women volunteered and completed the study (Table 1). All subjects were deemed healthy by the Physical Activity Readiness Questionnaire [12], and were not taking any other medications or supplements which could influence the results of the study. Experimentation occurred over a 3-week period during June 1996. All procedures undertaken were approved by the appropriate Human Subjects Review Board prior to experimentation. Participants were informed of the possible risks and benefits associated with the study prior to the signing of an informed consent form.

### Design and Procedures

**Baseline Testing (Visit One).** Following the explanation and signing of the informed consent, the subjects were randomly assigned to the ginseng or placebo group. Measures of height, weight, and body composition were then obtained. Body composition was determined from skinfold thickness from chest, abdomen, and thigh (men) and triceps, suprailliac, and thigh (women) [13,14]. The participants were fitted with a Polar heart rate monitor and following a 15-minute rest period sitting HR and blood pressures were obtained.

Participants were instructed in the use of the Borg [15] rate of perceived exertion (RPE) scale, and to indicate when they were approximately 1 minute from exhaustion, prior to performing a symptom-limited graded exercise test (SL-GXT) using a Schwinn Air-Dyne Ergometric Exerciser. The protocol was continuous with increments of 50 Watts (W) every 2 minutes until voluntary exhaustion. During the final minute of each stage and upon test termination HR and RPE's were obtained. During the final minute a nose clip was placed on the participants and, using a two-way valve, a 30-second sample of expired air was collected into a 100 liter (L) collection bag. Ventilations were measured using an American Meter Company gas meter. Gas fractions were determined using an Ametek Infra-red carbon dioxide (CO<sub>2</sub>) gas analyzer followed by an Ametek oxygen (O<sub>2</sub>) analyzer. All instruments were calibrated prior to testing, and all gas sample data corrected to standard temperature, pressure, dry values (STPD). Upon termination of the test the subjects were allowed an active cool down.

In addition to ventilatory and gas measures, blood samples

were obtained 3 minutes after termination of the test. The procedure for this was to clean the finger and test surface with a Spongette Alcohol Wipe. The participant's finger was then pierced (perpendicular to the finger print lines) using a Micro-tainer sterilized disposable blood lancet and the blood collected in three disposable 30T1 capillary tubes. The capillary tubes were then placed in an IEC/MB Micro Hematocrit centrifuge for 4 minutes to separate the cells from the plasma. Hematocrit levels were read from one of the capillary tubes using a Damon/IEC Division Micro-Capillary Reader. The plasma from the individual's capillary tubes was pipetted into individualized, labeled test tubes and stored on ice. Lactate reagents and standards were prepared in accordance with the manual procedures outlined in Sigma Diagnostics Lactate Procedure number 735 [16] and control solutions prepared in accordance with Sigma Diagnostics Metabolite Control catalog numbers S3005 and S3006 instructions. A Bausch and Lomb Spectronic 20 spectrophotometer set at 540 nanometers was used for the quantitative, enzymatic determination of the lactate in the plasma. The resultant data was converted to millimoles/liter (mmol/l).

**Ginseng Supplementation.** The ginseng used in this study was a commercially manufactured standardized 200 mg dosage of 7% Panax ginseng. The placebo was manufactured to be identical in appearance and content, minus the ginseng. Participants were instructed to take one tablet each morning 30 minutes prior to eating breakfast, and not to modify their regular dietary practices for the duration of the testing period.

**Retesting (Visit Two).** Following 21 days of Panax ginseng or placebo supplementation the participants were retested using procedures identical to the baseline tests.

### Analysis of Data

Means and standard deviations were determined for the demographic and anthropometric data (age, height, weight). To determine within and between group differences and a repeated measures analysis of variance (ANOVA) was performed on the variables of VO<sub>2peak</sub>, T, WK<sub>peak</sub>, HR and RPE at 150 W, 200 W and peak, and plasma lactate and hematocrit at peak to determine differences among and within the two treatment groups. Additionally an analysis of covariance (ANCOVA) was performed on the variables of VO<sub>2peak</sub> and HR<sub>peak</sub>, using the pretreatment score as the covariate. The alpha level was set at 0.05 for all statistical analyses.

**Table 1.** Participant Characteristics at Baseline

|                                    | Ginseng (n=13) | SD   | Placebo (n=15) | SD   |
|------------------------------------|----------------|------|----------------|------|
| Age (year)                         | 23.0           | 3.2  | 23.7           | 3.2  |
| Height (cm)                        | 173.1          | 9.4  | 178.4          | 8.3  |
| Weight (kg)                        | 71.1           | 11.3 | 79.4           | 19.2 |
| Bodyfat (%)                        | 16.4           | 8.4  | 15.4           | 7.7  |
| VO <sub>2peak</sub> (ml/kg/minute) | 51.0*          | 9.9  | 45.4*          | 9.3  |

\* Significant difference for between group effect (p≤0.05).

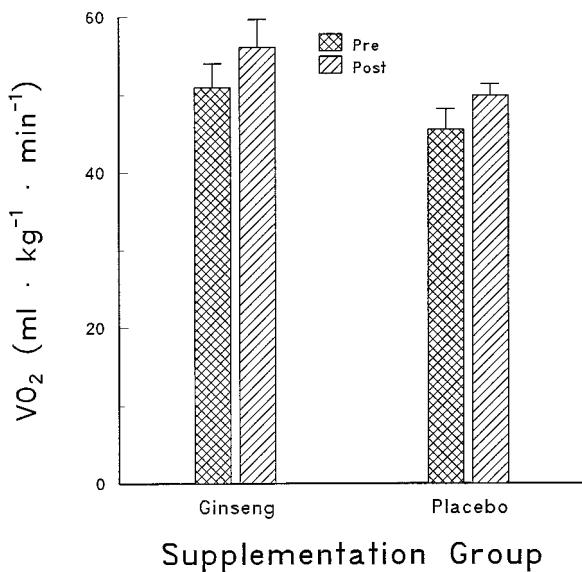
**RESULTS**

No participant reported modifications to their diet or changes in health status which could have affected the outcome of the study. Two participants did report mild diarrhea symptoms limited to the first week of supplementation. During the course of the study four and three participants were lost from the ginseng and placebo groups respectively due to attrition unrelated to the supplementation. Group means and standard deviations before and after treatment are shown in Table 1. The groups were evenly matched for age, height, weight and body composition.

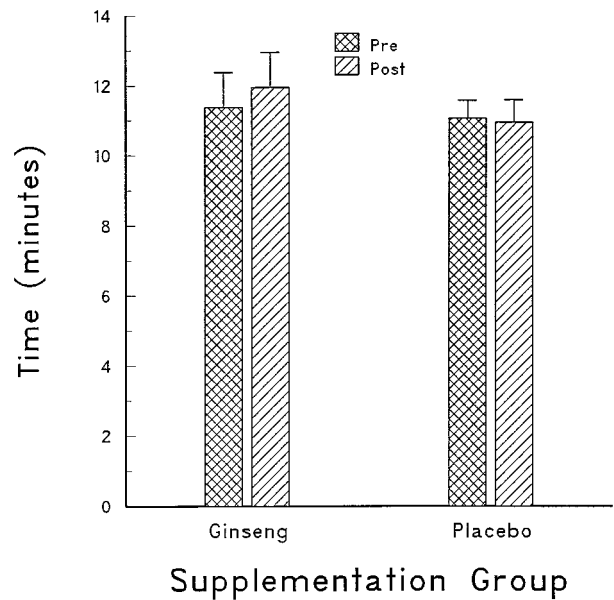
Significant between group differences for  $VO_{2peak}$  and  $HR_{peak}$  were noted prior to, and after supplementation. Despite this a within group ANOVA did not reveal a significant treatment or interaction effect for any of the variables observed. Similarly, the covariate analyses found a nonsignificant treatment effect, as illustrated in Figs. 1–3. Fig. 1 illustrates that increases in  $VO_{2peak}$  found post supplementation were similar for both treatment groups. Although the ginseng group were able to perform slightly longer post supplementation, as seen in Fig. 2, this was not significant. Fig. 3 shows the HR responses of the two groups pre and post treatment.

**DISCUSSION**

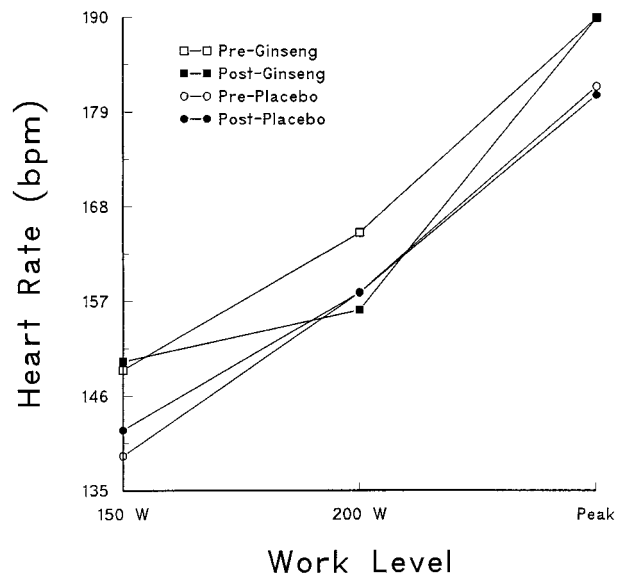
The results of this study do not support an ergogenic effect on maximal exercise performance following a 3-week ingestion period of 200 mg, 7% Panax ginseng in healthy young adults with moderate exercise capacities and unrestricted diets. These findings are in agreement with some studies and in conflict



**Fig. 1.**  $VO_{2peak}$  values prior to and following 21 days of Panax ginseng supplementation.



**Fig. 2.** Total exercise time prior to and following 21 days of Panax ginseng supplementation.



**Fig. 3.** Group HR responses to maximal graded exercise testing.

with others using various protocols and ginseng supplements, as shown in Tables 2 and 3.

In humans, the research evidence for the use of ginseng as an ergogenic aid is neither voluminous nor is it in agreement [5]. Engels, Said, Wirth, and Zhu [8] found no change in values of HR, ventilation ( $V_E$ ), and  $VO_2$  during a maximal graded exercise in women following 60 days of 200 mg of ginseng per day (a longer period than the current study). Morris, Jacobs, and Klugerman [9] found no significant effect after 7 days of ginseng or placebo ingestion on a pedal to exhaustion bicycle test. Distance runners have also showed no effect with ginseng administration [10,11] (Table 3).

**Table 2.** Ginseng Supplementation Studies Supporting an Ergogenic Effect

| Author                 | Population | Dose                                 | Results   | Comment  |
|------------------------|------------|--------------------------------------|---|--|
| Pieralisi (1991) [7]   | n=50       | G115* 6 weeks                        | ↑ VO <sub>2peak</sub> , V <sub>E</sub> , VCO <sub>2</sub> at submax levels, only in subjects with initial VO <sub>2peak</sub> < 60 ml/kg/minute | Male sports teachers 21–47 years old                   |
| McNaughton (1988) [5]  | n=30       | 1000 mg* 6 weeks<br>Panax vs Russian | ↑ VO <sub>2max</sub><br>↑ HR recovery   | Effects only in Panax ginseng                          |
| Von Ardenne (1987) [6] | n=63       | 200 mg G115* 4 weeks                 | Change in blood within 2 hours  | 42–65 years old No control grp, not a blinded protocol |

**Table 3.** Ginseng Supplementation Studies Without an Ergogenic Effect

| Author              | Population | Dose                       | Results   | Comment                                 |
|---------------------|------------|----------------------------|---|---|
| Dowling (1996) [11] | n=20       | 3.4 ml/day* 6 weeks        | ↔ HR, VO <sub>2</sub> , V <sub>E</sub> , RPE, RER | Trained distance runners                |
| Engles (1995) [8]   | Females    | 200 mg* 60 days            | ↔ HR, V <sub>E</sub> , VO <sub>2</sub>            | Only female subjects                    |
| Morris (1994) [9]   | n=8        | 7 days                     | ↔ VO <sub>2</sub>                                 | Low subject number                      |
| Teves (1983) [10]   | n=6        | 2 g Panax ginseng* 4 weeks | ↔ VO <sub>2peak</sub>                             | Marathon runners and low subject number |

In contrast, several studies have reported positive results following ginseng supplementation (Table 2). Von Ardenne and Klemm [6], observed improvements in the relative arterial pO<sub>2</sub> levels of the blood within 2 hours of ingesting ginseng, which reached significance at 3 weeks. High dosages of ginseng have often been used to investigate its effects. McNaughton et al [5], gave 1000 mg per day dosage for 6 weeks with 30 subjects in a randomized triple crossover design using placebo, Russian, or Chinese ginseng groups. They found an increase in VO<sub>2peak</sub> and in HR recovery time with only the Chinese ginseng. Their findings are difficult to place into context within the literature due to a failure to report any actual data or to employ a control group.

Although the 200 mg dosage and 7% strength of the supplementation used in the current study, is lower than in some other studies, it is still considerably higher than most commercially available dosages (100–200 mg/4% per day). Additionally, although ginseng is thought to be relatively safe, long-term use or high dosages have been reported to cause adverse reactions including, sleeplessness, euphoria, agitation, insomnia, nervousness, hypertension, diarrhea, edema and mastalgia [4]. Studies most relative to the dosage and administration period of this research have reported no ill effects for the treatment condition [5,6,7].

The current data extends previous findings [7,10,11] which refute a significant ergogenic effect in subjects with high exercise capacities. Pieralisi, Ripari, and Vecchiet [7], suggested the metabolic and physiological responses of ginseng ingestion resemble those occurring due to aerobic endurance training and may partly explain the generally poorer response results found in aerobically trained individuals. Pieralisi [7] gave Geriatric Pharmacon G115 capsules to 50 healthy male sports teachers 21 to 47 years old in a double blind, randomized, crossover study. They found significant decreases in HR, VO<sub>2</sub>, V<sub>E</sub>, and

plasma lactate levels with ginseng supplementation vs. placebo at stage four of the Bruce [17], treadmill protocol (4.2 mph/16% gradient, approximate VO<sub>2</sub> of 47 ml/kg/minute). Interpretation of the data is difficult because values for VO<sub>2</sub> reported for maximal workload are different to those reported for maximal O<sub>2</sub> consumption by up to 22%. The reasons for these discrepancies are unclear in the text. Despite this, if the O<sub>2</sub> consumption at each subject's maximal workload is considered, there was a difference between subjects with pretreatment VO<sub>2peak</sub> levels below 60 ml/kg/minute and those above this level. No significant difference was found in the higher performance group. In the post-exercise period significantly lower values were measured for VO<sub>2</sub>, VCO<sub>2</sub>, V<sub>E</sub>, plasma lactate, and HR in the subjects receiving the ginseng preparation. The conclusions of the research by Pieralisi [7] are not supported by this paper because the untrained, healthy, young adults in this study showed no significant response to ginseng treatment (only one subject in this group had a VO<sub>2peak</sub> greater than 60 ml/kg/minute).

## CONCLUSIONS

The results of this study do not support an ergogenic effect on peak aerobic exercise performance following a 3-week supplementation period of 200 mg 7% Panax ginseng in healthy young adults with moderate exercise capacities and unrestricted diets.

Until standardization of the products and research on large numbers of subjects is incorporated, the mechanisms of effect, if any, for ginseng cannot be explained. Future research must concentrate on testing varying standardized levels of ginsenosides with subjects of different age groups, and fitness levels.

## ACKNOWLEDGMENTS

We are grateful for the time and effort of all the subjects, data collection assistance from Mr. Mark Smith, and the support of the Graduate School at Western Carolina University.

## REFERENCES

1. Bahrke MS, Morgan WP: Evaluation of the ergogenic properties of ginseng. *Sport Med* 18(4):229–248, 1994.
2. Beltz SD, Doering PL: Efficacy of nutritional supplements used by athletes. *Clin Pharm* 12:900–908, 1993.
3. Lewis WH: Ginseng: A medical enigma. In Etkin NL (ed): "Plants Used in Indigenous Medicine and Diet: Biobehavioral Approaches." New York: Redgrave, pp 290–305, 1986.
4. Siegel RK: Ginseng abuse syndrome: problems with the panacea. *JAMA* 241:1614–1615, 1979.
5. McNaughton L, Egan G, Caelli G: A comparison of Chinese and Russian ginseng as ergogenic aids to improve various facets of physical fitness. *Int Clin Nut Rev* 19(1):32–35, 1988.
6. Von Ardenne M, Klemm W: Measurements of the increase in the difference between the arterial and venous Hb-O<sub>2</sub> saturation obtained with daily administration of 200 mg standardized ginseng extract G115 for four weeks. *Panminerva Med* 29:143–150, 1987.
7. Pieralisi G, Ripari P, Vecchiet L: Effects of a standardized ginseng extract combined with dimethylaminoethanol bitartrate, vitamins, minerals, and trace elements on physical performance during exercise. *Clin Ther* 13(3):373–382, 1991.
8. Engles HJ, Said J, Wirth JC, Zhu W: Effect of chronic ginseng intake on metabolic responses during and in the recovery from graded maximal exercise. (Abstract). *Med Sci Sports Exerc* 27(5): S147, 1995.
9. Morris AC, Jacobs I, Klugerman TM: No ergogenic effect of ginseng extract ingestion. (Abstract). *Med Sci Sports Exerc* 26(5): S6, 1994.
10. Teves JE, Wright JE, Welch MI: Effects of ginseng on repeated bouts of exhaustive exercise. (Abstract). *Med Sci Sports Exerc* 15:S162, 1983.
11. Dowling EA, Redondo DR, Branch JD, Jones S, McNabb G, Williams MH: Effect of *eleutherococcus senticosus* on submaximal and maximal exercise performance. *Med Sci Sports Exerc* 28(4):482–489, 1996.
12. Thomas S, Reading J, Shepard RJ: Revision of the Physical Activity Readiness Questionnaire (PAR-Q). *Can J Sport Sci* 17:338–345, 1992.
13. Pollock ML, Wilmore JH: "Exercise in Health and Disease: Evaluation and Prescription for Prevention and Rehabilitation," 2nd ed. Philadelphia: WB Saunders, 1984.
14. Siri WE: Body composition from fluid spaces and density. *Univ Calif Donner Lab Med Phys Rep*, March 1956.
15. Borg GAV: Psychophysical bases of perceived exertion. *Med Sci Sports Exerc* 14:377–381, 1982.
16. Bruce RA: Exercise testing in patients with coronary heart disease. Principles and normal standards for evaluation. *Ann Clin Res* 3:323–332, 1971.

*Received December 1997; revision accepted April 1998.*