Ginseng, American

Panax quinquefolius L.

[Fam. Araliaceae]

**Overview**
Ginseng is one of the most widely used medicinal herbs with at least six species used in traditional systems of medicine. Most world production and trade of ginseng involves two species: Asian ginseng (Panax ginseng) and American ginseng (P. quinquefolius). The U.S. exports up to two million pounds of cultivated ginseng roots annually and approximately 132,000 pounds of wild ginseng, primarily to China. Wisconsin produces 97% of all U.S.-grown ginseng. American ginseng consumption in the U.S. trails far behind that of Asian ginseng and eleuthero (also called Siberian ginseng, Eleutherococcus senticosus). Besides being sold as a dietary supplement, American ginseng’s primary use is as an ingredient in beverages. Compared to the scores of clinical trials on Asian ginseng, few clinical studies have been conducted on American ginseng. Each species of ginseng has similar but distinct chemical profiles, and therefore exhibits different pharmacological and clinical activity.

**Primary Uses**
- Reduces postprandial glycemia in non diabetics and in patients with type 2 diabetes

**Other Potential Uses**
- Possible reduction of ventilation and increased oxygen consumption ability during submaximal exercise (based on small trial)
- Possible benefit in mental performance (proofreading) based on small trial
- In Traditional Chinese Medicine (TCM), American ginseng is used for various tonic purposes

**Pharmacological Actions**
- **Root Powder**: Reduced postprandial glycemia in type 2 diabetes mellitus and in nondiabetic subjects.
- **Root Extract**: Acted on the Fourier components of the radial artery pulse, increased respiratory endurance in exercise.

**Dosage and Administration**
- For therapeutic effectiveness, American ginseng is probably optimally used continuously over an extended period of time, although published clinical trials over 90 days are lacking.
- **Decoction**: 3–6 g dried root simmered in 720–960 ml water for approximately 45 minutes; alternatively, 2–9 g simmered.
- **Infusion**: 150–240 ml boiling water poured over 1–2 g dried root and steeped for 20 minutes.
- **Dry Root Powder**: 3 g daily for postprandial glycemia in type 2 diabetes mellitus.
- **Dry Extract**: 330 mg, 3 times daily for improving physical endurance during work.

**Contraindications**
None known.

**Pregnancy and Lactation**: None known.

**Adverse Effects**
None known.

**Drug Interactions**
None known. Diabetics may need to monitor insulin levels due to hypoglycemic action.
In 6 clinical studies on American ginseng that included a total of 126 participants, all but one (ergonomic response to intense exercise) demonstrated positive effects on athletic performance, diabetes, and circulation. One double-blind, placebo-controlled (DB, PC) study and one PC, crossover (CO) study reported beneficial effects of an American ginseng root powder on postprandial glycemia in type 2 diabetes mellitus subjects. A subsequent randomized, PC, crossover study revealed that powdered American ginseng reduced postprandial glycemia in healthy individuals. Improved athletic performance was the focus of two small PC studies; one study showed no positive effect, and the other resulted in reduced ventilation requirements and increased ability to consume oxygen in submaximal exercise. One small comparative, PC study examined the effects of ginseng on psychomotor skills and found Asian and American ginseng to have equal effects on improving proofreading, error-detection, and mood-fatigue.
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OVERVIEW
Medicinal use of Asian ginseng (Panax ginseng) dates back at least 5,000 years in Asia. American ginseng is produced in North America from a plant that has similar but different chemistry and slightly different biological activity. In the U.S., it is used in a wide range of tonic, energy, and immune-stimulating dietary supplements.

USES
Promotes blood sugar metabolism in healthy people and persons with type 2 (non-insulin dependent) diabetes.

DOSAGE
In general, short-term use may not be beneficial, so continued use over an extended period of time is usually recommended. However, American ginseng was shown in clinical trials to be effective in lowering blood sugar levels directly after meals in both healthy and diabetic (type 2) persons when taken during or just after the meal.

DECOCTION (TEA): Simmer 3–6 g dried root in 720–960 ml water for approximately 45 minutes; alternatively, simmer 2 to 9 g.

INFUSION (TEA): Pour 150–240 ml boiling water over 1–2 g dried root and steep for 20 minutes.

DRY ROOT POWDER: 3 g daily for regulation of post-prandial (after meal) glycemia (blood sugar level) in type 2 diabetes mellitus (non-insulin dependent diabetes).

DRY EXTRACT: 330 mg, 3 times daily, for improvement of oxygen uptake during moderate exercise.

CONTRAINDICATIONS
None known.

PREGNANCY AND LACTATION: None known.

ADVERSE EFFECTS
None known.

DRUG INTERACTIONS
None known. Diabetics may need to monitor insulin levels because of the blood sugar-lowering effect.

Comments
When using a dietary supplement, purchase it from a reliable source. For best results, use the same brand of product throughout the period of use. As with all medications and dietary supplements, please inform your healthcare provider of all herbs and medications you are taking. Interactions may occur between medications and herbs or even among different herbs when taken at the same time. Treat your herbal supplement with care by taking it as directed, storing it as advised on the label, and keeping it out of the reach of children and pets. Consult your healthcare provider with any questions.

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OVERVIEW

Ginseng is one of the most widely used medicinal herbs with at least six species used in traditional systems of medicine. Most world production and trade of ginseng involves two species: Asian ginseng (Panax ginseng) and American ginseng (P. quinquefolius) (AAFC, 2000). According to TRAFFIC USA (the division of the World Wildlife Fund that monitors the status of threatened and endangered species), no other plant better represents the cultural and economic value of medicine harvested from the wild in North America than American ginseng (Robbins, 1997). The U.S. Department of Commerce (USDOC) measures ginseng production separately from other herbs due to its significant economic value. The U.S. exports up to two million pounds of cultivated ginseng roots annually (USDOC, 1995; USFWS, 1999a) and approximately 132,000 pounds of wild ginseng, primarily to China (Robbins, 1997; USDOC, 2000). Wisconsin produces 97% of all U.S.-grown ginseng. In 1998, Canada produced over 60% of the world supply of American ginseng (approximately four million pounds annually), the U.S. produced approximately 30%, and China produced the balance (approximately 7%). China remains the largest consumer of American ginseng (Xiao, 2000).

Native to North America, American ginseng is used in traditional indigenous medicine, particularly by the Cherokee, Creek, Iroquois, Menominee, Ojibwa, Pawnee, and Seneca tribes (Foster, 1999; Heffern, 1976; Moerman, 1998). In 1718, Canadian Jesuits began organizing the collection of American ginseng from the wild for export to China (Rafinesque, 1830), where in 1765, during the Qing dynasty, it was added to the Supplement to the Grand Materia Medica (a.k.a., Omissions from Ben Cao Gang Mu), by Zhao Xuemin (Bensky et al., 1986; Foster and Chongxi, 1992). American ginseng (xi yang shen) has since become integrated into Traditional Chinese Medicine (TCM) with indications for use distinctly different from those of Asian ginseng (ren shen) (Awang, 1998; Xiao, 2000). American ginseng became official in the United States Pharmacopeia (USP) in 1842. It was removed from the USP in 1882, but its popular use by American Eclectic medical doctors and homeopaths continued (Felter and Lloyd, 1898; Foster, 1999; HPUS, 1992; Millsapugh, 1892; Scudder, 1891). Its primary use was as a stomach tonic, though it was also used for nervous exhaustion from overwork (Felter and Lloyd, 1898; Scudder, 1891). By the late 19th century, American ginseng was already a threatened species due to overcollecting, and extensive cultivation efforts began (Millsapugh, 1892; USFWS, 1977; Wood et al., 1926). In 1947, the cultivation of American ginseng also began in China, but did not become large-scale until 1980 (AAFC, 1998; Xiao, 2000). American ginseng consumption in the U.S. trails far behind that of Asian ginseng and eleuthero (previously called Siberian ginseng, Eleutherococcus senticosus). Besides being sold as a dietary supplement, American ginseng’s primary use is as an ingredient in beverages. Compared to the scores of clinical trials on Asian ginseng, few clinical studies have been conducted on American ginseng (see table below). Each species of ginseng has similar but distinct chemical profiles, and therefore exhibits different pharmacological and clinical activity.

DESCRIPTION

American ginseng root consists of the mature, dried, (usually) cultivated root of Panax quinquefolius L. [Fam. Araliaceae], harvested in the fall, separated from rhizomes, dried at low temperature, and containing no less than 1.0% of ginsenoside Rb1 as determined by HPLC (PPRC, 2000). American ginseng is harvested usually after a minimum of five years growth, although many roots cultivated in North America are harvested after four years. The highest-quality dried roots break with a somewhat soft and waxy fracture, while immature or undersized roots dry hard and glassy (USDA, 1978). Plant maturity can be determined before harvesting using two methods: counting the number of leaves (a.k.a., prongs) and/or removing soil where the stem joins the root to count the number of bud scale scars on the root. A single scar is produced every autumn after the plant’s stem falls (USFWS, 1999b). In December 1998, China issued quality control standards for American ginseng and its products entitled Grade and Quality Standards of Products of Processed American Ginseng (State Standard of People’s Republic of China, 1998).

PRIMARY USES

Endocrinology
- Reduces postprandial glycemia in non-diabetics and type 2 diabetes patients (Vuksan et al., 2001, 2000a, 2000b)

OTHER POTENTIAL USES

Sports Medicine
- May improve cardio-respiratory endurance during submaximal work (reduced ventilation and increased oxygen consumption ability) (Goode et al., 1993)
Cognition
- May improve mood-fatigue, may improve proofreading error detection (Johnson et al., 1980)

Traditional Chinese Medicine (TCM)
- Deficiency of qi (diminished function of the internal organs and lowered body resistance); deficiency of yin (lack of body fluid, vital essence and blood, often resulting in endogenous heat); internal-heat (heat syndrome typically manifested by fever, night sweating, thirst, and constipation); cough and asthma; phlegm mixed with the blood; dysphoria and tiredness; diabetes; dry mouth and throat. (These are terms and concepts used in TCM and may not always be correlated easily to Western biomedical terminology.)

Dosage
Internal Crude Preparations
Decoction: 3–6 g dried root simmered in 720–960 ml water for approximately 45 minutes (PPRC, 2000; Yen, 1992). Other sources recommend simmering 2–9 g (Bensky et al., 1986; Foster and Chongxi, 1992).
Infusion: 150–240 ml boiling water poured over 1–2 g cut, dried root and steeped for 20 minutes (Xiao-fan and Liscum, 1996).
Root Powder (Dry): 1–3 g in capsules 40 minutes prior to meal for normalization of blood sugar in postprandial glycemia with or after meal (Vuksan et al., 2001).
Whole Root Powder: 3 g daily for postprandial glycemia in type 2 diabetes mellitus (Vuksan et al., 2000a).
Dry Extract: 330 mg, 3 times daily for improving physical endurance during work (Goode et al., 1993).

Duration of Administration
According to previous Eclectic medical use, American ginseng does not have an immediate effect and short-term use provides little benefit. Thus, continued use over an extended period of time is usually recommended (Felter and Lloyd, 1898). However, recent clinical trials have demonstrated an almost immediate effect in blood sugar metabolism when taken before meals (Vuksan et al., 2001, 2000a).

Chemistry
American ginseng has a chemical profile distinct from that of Asian ginseng. Its concentration of ginsenosides varies considerably depending on root age, month of harvest, method of drying, and method of analysis (Court et al., 1996; Reynolds, 1998). Studies identified 3.0–7.3% dammarane-type triterpene glycosides (saponins) including 1.22–1.6% ginsenoside Rb1, 0.02–0.27% ginsenoside Rb2, 0.18–0.29% ginsenoside Rc, 0.09–0.8% ginsenoside Rd, 0.9–1.1% ginsenoside Re, 0.12–0.2% ginsenoside Rg1; oleanolic acid derived ginsenoside: 0.1–0.25% ginsenoside Ro (Chuang et al., 1995; Li et al., 1996; Yen, 1992); 0.78% malonyl (m) ginsenosides: 0.78% m-Rb1, 0.20% m-Rb2, 0.24% m-Rc, 0.14% m-Rd (Ren and Chen, 1999); dammarane-type triterpene oligoglycosides: quinquenosides I, II, III, IV, V (Yoshikawa et al., 1998); acetylenic alcohols: panaxyol, falcarnidol, panaxydol, and panaxtriol (Wang et al., 2000); a homodimeric protein quinqueginsin (Wang and Ng, 2000); and 0.04–0.97% volatile oil (Zheng et al., 1989).

Due to the potential adulteration of American ginseng with Asian ginseng in the marketplace, methods have been developed to differentiate the two species. For example, 24(R)-pseudo-ginsenoside-F11 is a characteristic constituent of American ginseng but occurs only in minute quantities in Asian ginseng, whereas ginsenoside-RF is the characteristic constituent of Asian ginseng that is lacking in American ginseng (Chan et al., 2000; Dou et al., 1998; Shaw and But, 1995; Wenkui et al., 2000). Malonyl ginsenosides are found at much lower levels in Asian ginseng, at 10% total ginsenoside content compared to 40% total ginsenoside content in American ginseng (Awang, 2000). Thorough reviews of ginseng chemistry have been or will soon be published (Court, 2000; Chen et al., 2003).

Pharmacological Actions
Human
American ginseng whole root powder reduced postprandial glycemia in type 2 diabetes mellitus and in nondiabetic subjects (Vuksan et al., 2000a; 2000b). American ginseng root powder reduced glycemia in healthy individuals (Vuksan et al., 2001). American ginseng total extract demonstrated specific effect on the Fourier components of the radial artery pulse, confirming TCM descriptions (Wang et al., 1994), and increased respiratory endurance in exercise (Goode et al., 1993).
Traditional Chinese Medicine (TCM) Actions
Dispels wind (exogenous pathogenic factor with symptoms such as upper respiratory catarrh with headache and urticaria) and remove heat (symptoms such as fever, flushed face, thirst); relieve cough and resolve phlegm (secretions of the respiratory system) (PPRC, 2000).

Animal
American ginseng root stimulated copulatory behavior in male rats (Murphy et al., 1998); aqueous extract possessed significant gastromodulating effect on brain neuronal activity in rats (Yuan et al., 1998a, 1998b); methanolic American ginseng extract exhibited liver-protective effect against D-galactosamine- and lipopolysaccharide-induced injury in mice (Yoshikawa et al., 1998); aqueous American ginseng extract significantly exhibited hypoglycemic activity in mice (Oshima et al., 1987); inhibitory effect on the cerebral cortex and moderately stimulates subcortical centers (Bensky et al., 1986); saponin extract decreased plasma glucose levels in resting rats (Martinez and Staba, 1984). Research on fractions and isolated constituents have been conducted, yielding results which may or may not be consistent with studies on whole American ginseng extracts: isolated saponins significantly elevated total and maximum heat production and improved cold tolerance in rats (Wang and Lee, 2000); pseudo-ginsenoside-F11 antagonized scopolamine-induced memory impairment in mice and rats (Li et al., 1999); ginsenoside Rb1 prevented scopolamine-induced amnesia in rats (Benishin et al., 1991).

In vitro
American ginseng root extract showed effective antioxidant activity in both lipid and aqueous mediums by chelation of metal ions and free radical scavenging (Kitts et al., 2000); ethanolic extract showed nicotinic activity by displacement of 3H-(−)nicotine from human brain cortical membranes (Lewis et al., 1999); inhibited thrombin-induced endothelin release in cultured human umbilical vein endothelial cells (Yuan et al., 1999); ethyl acetate American ginseng extract inhibited nitrate production by inducible nitric oxide synthase (iNOS) (Wang et al., 2000);
isolated quinqueginsin inhibited human immunodeficiency virus-1 reverse transcriptase (Wang and Ng, 2000); standardized extract and breast chemotherapeutic drugs synergistically inhibited MCF-7 breast cancer cell growth (Duda et al., 1999); extract exhibited estrogenic activity in MCF-7 breast cancer cells (Duda et al., 1997).

**MECHANISM OF ACTION**
The mechanisms of action of American ginseng are not fully understood. Some suggested mechanisms include:

**Animal**
- Reduced plasma prolactin levels and significantly stimulated copulatory behavior due to ginseng-induced alterations in dopaminergic neurotransmission (Murphy et al., 1998).
- Research also suggests that American ginseng's apparent increase of the male sexual arousal response is the result of relaxing and vasodilating the corpus cavernosum, allowing greater erectile performance, which appears to occur by means of an interaction with nitric oxide synthase (Nocerino et al., 2000).
- Regulated GABAergic neurotransmission (Yuan et al., 1998a; Yuan et al., 1998b).

**In vitro**
- Facilitated the release of acetylcholine (ACh) from hippocampal slices (ginsenoside Rb1, isolated from American ginseng roots and fibers), which is associated with an increased uptake of choline into nerve endings. The ability of Rb1 to prevent memory deficit in animal experiments may be related to ACh metabolism in the central nervous system (Benishin et al., 1991).

**CONTRAINDICATIONS**
None known.

**Traditional Chinese Medicine (TCM) Contraindications**
- Cold-Damp Stomach (condition marked by intolerance of cold and abdominal distention) (Bensky et al., 1986).

**PREGNANCY AND LACTATION:** No known restrictions (McGuffin et al., 1997).

**ADVERSE EFFECTS**
None known.

**DRUG INTERACTIONS**
None known. Insulin levels in diabetic patients may need monitoring due to American ginseng's blood sugar modulating effect.

**AMERICAN HERBAL PRODUCTS ASSOCIATION (AHPA) SAFETY RATING**
**CLASS 1:** Herbs that can be safely consumed when used appropriately (McGuffin et al., 1997).

**REGULATORY STATUS**
**CANADA:** Food, if no therapeutic claims are made, and New Drug if drug claims are made (HPB, 1993) except as per the Traditional Herbal Medicine (THM) Policy. Permitted as a THM, if the claim(s) are supported by traditional references, requiring premarket authorization and assignment of a Drug Identification Number (DIN) (Health Canada, 1999). Also, permitted as a homeopathic over-the-counter (OTC) drug with premarket authorization and assignment of a DIN (Health Canada, 2001).

**CHINA:** Regulated as a drug, which must meet the State Standard of People's Republic of China 1998: Grade and Quality Standards of American Ginseng. American ginseng dried roots and teas are Class 3 materials (herbal pharmaceuticals). American ginseng capsules are also Class 3 drugs, but require additional premarket licenses and inspection from the Ministry of Health (AAFC, 1998; Xiao, 2000).

**FRANCE:** No official monograph for this species of Panax.

**GERMANY:** No official monograph for this species of Panax.

**ITALY:** No official monograph for this species of Panax.

**JAPAN:** Used in traditional Kampo medicine (Rister, 1999). Before May 23, 2000, American ginseng was considered a drug; now deregulated by Japan's Ministry of Health and Welfare, and may be sold as a food product without medical efficacy claims (USDS, 2000).

**SWEDEN:** Possible Natural Remedy for self-medication requiring advance application for marketing authorization. As of January 2001, no American ginseng products have been listed in the Medical Products Agency (MPA) “Authorised Natural Remedies” (MPA, 2001). Food, if no therapeutic claims are made.

**SWITZERLAND:** No official monograph for this species of Panax.

**U.K.** Entered in General Sales List, Table A (internal or external use) of Schedule 1 (subject to a full product license) (GSL, 1994).

**U.S.:** Dietary supplement (USC, 1994). The homeopathic tincture (1X) of the fresh or dried root is an OTC Class C drug of the Homeopathic Pharmacopoeia of the United States (HPUS, 1992).

**CLINICAL REVIEW**
Six studies are outlined in the following table, “Clinical Studies on American Ginseng,” including a total of 126 participants. All but one of the studies (Morris et al., 1996), demonstrated positive effects on diabetes, circulation, or oxygen utilization during athletic performance. One double-blind placebo-controlled (DB, PC) study and one PC crossover (CO) study reported beneficial effects of American ginseng root powder on postprandial glycemia in type 2 diabetes mellitus subjects (Vuksan et al., 2000a; 2000b). A subsequent randomized, PC, CO study evaluated the effects of powdered American ginseng on postprandial glycemia in healthy individuals (Vuksan et al., 2001). These subjects experienced a reduction in postprandial glycemia. Improved athletic performance was the focus of two PC studies (Goode et al., 1993; Morris, 1996). One small comparison, PC study examined the effects of ginseng on psychomotor skills and found Asian and American ginseng to have equal effects on improving proofreading error-detection and mood-fatigue (Johnson et al., 1980). All these studies are small and need confirmation in larger trials. The evidence on American ginseng’s ability to lower postprandial blood sugar levels in both healthy individuals and type 2 diabetics in one dose is mounting but needs validation in larger, longer-term studies.

**BRANDED PRODUCTS**
Chai-Na-Ta® CNT2000™ capsules: Chai-Na-Ta Corp., 5965 205A Street / Langley, BC / V3A 8C4 / Canada / Tel.: (800) 406-7668 / Fax (604) 533-8891 / www.chainata.com. One capsule, standardized to 6% ginsenosides, contains 500 mg of 3-year-old Ontario-grown, dried and ground American ginseng root, standardized to 6% ginsenosides.


## Clinical Studies on American Ginseng (Panax quinquefolius L.)

### Athletic Performance

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Subject</th>
<th>Design</th>
<th>Duration</th>
<th>Dosage</th>
<th>Preparation</th>
<th>Results/Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morris et al., 1996</td>
<td>Ergogenic response of ginseng to intense exercise</td>
<td>PC, CO n=8</td>
<td>1 week</td>
<td>8 or 16 mg/kg body weight</td>
<td>American ginseng root purified extract vs. placebo (brand not stated)</td>
<td>No significant intergroup differences in any measured parameters (oxygen uptake, heart rate, time to exhaustion, mean lactate concentration, rating of perceived exertion during submaximal ergometer exercise).</td>
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<tr>
<td>Goode et al., 1993</td>
<td>Sub-maximal and maximal performance as measured by oxygen consumption and ventilation</td>
<td>R, PC n=39 (mean age 22.5 years)</td>
<td>90 days</td>
<td>3 capsules per day of 330 mg; 2 with breakfast and 1 at supper</td>
<td>American ginseng root extract, encapsulated (brand not stated) vs. placebo (wheat flour)</td>
<td>Significant reduction (p&lt;0.01) in ventilation during submaximal exercise in post-test results compared to pretest values for entire ginseng group and compared to no significant change in placebo group. Increased ability to consume oxygen, especially in those who were less fit (not significant).</td>
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### Diabetes

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<tr>
<th>Author/Year</th>
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<th>Design</th>
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<tbody>
<tr>
<td>Vuksan et al., 2001</td>
<td>Postprandial glycemia in healthy individuals</td>
<td>R, PC, CO, Cm n=12</td>
<td>1 day</td>
<td>16 treatments: 2 capsules (1 g), 4 capsules (2 g), 6 capsules (3 g) or placebo at 40, 20, 10, or 0 minutes before 25 g oral glucose challenge</td>
<td>Chai-Na-Ta® capsules containing 500 mg 3-year old, dried and ground American ginseng root vs. placebo capsules (corn flour)</td>
<td>Ginseng reduced postprandial glyceria in nondiabetic subjects. Ginseng significantly lowered glyceria over last 45 minutes of test after doses of 1.2, or 3 g compared to placebo (p&lt;0.05). No significant differences among three doses. Glycemia in last hour of test and area under the curve significantly lower when ginseng was administered 40 minutes before challenge than when administered 20, 10, or 0 minutes before challenge (p&lt;0.05). Reductions were time-dependent and not dose-dependent, even though one of the doses (3 g) is relatively higher than normal.</td>
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<tr>
<td>Vuksan et al., 2000a</td>
<td>Postprandial glycemia in non-diabetic individuals and individuals with type 2 diabetes mellitus</td>
<td>R, DB, PC n=19 (mean age nondiabetics 34 years; mean age diabetics 62 years)</td>
<td>4 weeks</td>
<td>3 g/day, 40 minutes before or w/25 g oral glucose</td>
<td>Chai-Na-Ta® Ontario-American ginseng root vs. placebo (corn flour)</td>
<td>Type 2 diabetes mellitus subjects: ginseng significantly (p&lt;0.05) lowered incremental glyceria 22% ± 17% with glucose challenge and 19% ± 22%, 40 minutes before glucose challenge. Nondiabetic subjects: ginseng significantly (p&lt;0.05) lowered incremental glyceria 18% ± 31% when taken 40 minutes before glucose challenge, but no difference when taken with glucose challenge.</td>
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<tr>
<td>Vuksan et al., 2000b</td>
<td>Postprandial glycemia in individuals with type 2 diabetes mellitus</td>
<td>R, PC, CO n=10 type 2 diabetic individuals (6 males, 4 females) (age 63±2 years)</td>
<td>16 doses (at least 3 days washout between each dose)</td>
<td>3, 6, 9 g ginseng or placebo (120, 80, 40, or 0 minutes before receiving glucose challenge</td>
<td>Chai-Na-Ta® Ontario-American ginseng root encapsulated or placebo (corn flour)</td>
<td>Treatment with 3, 6, 9 g American ginseng significantly lowered incremental glyceria (p&lt;0.05). Reductions, however, occurred independent of the dose used. This effect was seen irrespective of the time of administration.</td>
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### Psychomotor Response

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<th>Author/Year</th>
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<tr>
<td>Johnson et al., 1980</td>
<td>Effect of whole ginseng on mental performance</td>
<td>DB, PC, Cm n=38 dental students 4 arms: Arm 1: n=8 males, 1 female Arm 2: n=5 males Arm 3: n=13 males, 1 female Arm 4: n=10 males (approximately 25 years old)</td>
<td>Over 32 days</td>
<td>All arms: Approximately 2 g/dose, 6–14 doses over 30 days</td>
<td>American ginseng root (Panax ginseng)</td>
<td>Both species of ginseng and eleuthero improved proofreading error detection, while only Korean and American ginseng improved mood-fatigue. None significantly affected mathematical performance and final grade performance, or the urinary concentrations of catecholamines.</td>
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**KEY:** C = controlled, CC = case-control, CH = cohort, CI = confidence interval, CM = comparison, CO = crossover, CS = cross-sectional, DB = double-blind, E = epidemiological, LC = longitudinal cohort, MA = meta-analysis, MC = multi-center, n = number of patients, O = open, OB = observational, OL = open label, OR = odds ratio, P = prospective, PB = patient-blind, PG = parallel group, PS = pilot study, R = randomized, RC = reference-controlled, RCS = retrospective cross-sectional, RS = retrospective, S = surveillance, SB = single-blind, SC = single-center, U = uncontrolled, UP = unpublished, VC = vehicle-controlled.