

COMPOSITIONS AND METHODS COMPRISING PANAX SPECIES

BACKGROUND OF THE INVENTION

Ginseng, the rhizome (root) of *Panax ginseng* (Asian ginseng, Korean ginseng) of the Araliaceae family, has been used in Oriental medicine since ancient times as a stimulant, tonic, diuretic, and digestive aid. In Europe, ginseng phytomedicines are sold over the counter and are taken to increase mental and physical performance, to provide resistance to stress and disease, and to relieve exhaustion. Because of the continual harvest and use over thousands of years, the natural supply of *P. ginseng* root was exhausted long ago. Today, almost all of the *P. ginseng* roots are cultivated in China, Korea, and Japan.

Many congeners of ginseng are used as medicines. The root of *P. quinquefolium* L. (American ginseng), which originally grew wild in North America, is now cultivated for export to the Asian market where it is used medicinally for slightly different purposes than *P. ginseng*. *P. notoginseng* (also known as Sanchi ginseng) has been used as a special herb in Traditional Chinese Medicine (TCM) from ancient times to the present. Other species such as, but not limited to, *P. japonicus*, *P. pseudo-ginseng*, *P. vietnamensis*, *Eleutherococcus senticosus* (Siberian ginseng), and other species, subspecies, or varieties have also been used in Asian phytomedicine.

The constituents of the *Panax* rhizomes (ginseng roots) have been investigated since the beginning of the 20th century. Several of the classes of compounds have been isolated and some of the individual chemical constituents have been studied for their biological effects. Some of the classes of chemical compounds that are ubiquitous to the various ginseng roots include the triterpene saponins, essential oil in which is contained the chemicals known as polyacetylenes, polysaccharides, sesquiterpenes, peptidoglycans, nitrogen-containing compounds, and others such as fatty acids, carbohydrates and phenolic compounds (2). The chemical constituents of the ginsengs that are believed to contribute to their pharmacological effects have been investigated extensively since the 1950s. The principal bioactive compounds based on these investigations are the triterpene saponins (e.g. ginsenosides), polyacetylenes, and the polysaccharides (2-7).

All of the *Panax* species contain a class of triterpene saponins collectively called

ginsenosides (or panoxosides). The ginsenosides contain a 4 trans-ring rigid steroid skeleton, and the individual ginsenosides differ by the number, type, and location of their sugar moieties, and the backbone structure of the triterpene or steroid moiety (3). The ginsenosides are named "ginsenosides R_x" wherein "x" corresponds to the sequence of R_f value of the spots when analyzed by thin layer chromatography. Among the known ginsenosides are R₀, R_{b1}, R_{b2}, R_c, R_d, R_e, R_f, R_{g1}, R_{g2}, R_{g3}, R_{g5}, R_{h1}, R_{h2}, R_i, and R_j. The ginsenosides are further categorized into groups based upon the backbone structure of the steroid moiety, and include those ginsenosides based on the 20(S) protopanaxadiol backbone (collectively the R_b group), the 20(S) protopanaxatriol backbone (collectively the R_g group), the ocotillol backbone, and the oleanane backbone. Specific ginsenosides in the R_b group include R_{b1}, R_{b2}, R_c, R_d and several other related compounds. Specific ginsenosides in the R_g group include R_g, R_e, R_f, R_{g2} and several other related compounds. Figure 5 depicts the chemical structures for R_{h1}, R_{h2}, R_{g3}, and R_{g5} (Glc = β-D-glucopyranosyl-, Glc-Glc = β-D-glucopyranosyl(1→2) β-D-glucopyranosyl-).

Overviews of the pharmacological effects of *P. ginseng* extracts and preparations (ginsenoside, polyacetylene and polysaccharide fractions) have been presented (2-8). The preparation and definition of products derived from ginseng is specified in various European pharmacopoeias. The Swiss pharmacopoeia, Pharmacopoea Helvetica (Commission Suisse de Pharmacopée), requires a total ginsenoside content, calculated as relative to the abundance of ginsenoside R_{g1}, of not less than 2.0%. According to the German pharmacopoeia (Herbal Medicine – Expanded Commission E Monographs, Blumenthal, M. et al., Integrative Medicine Communications, 2000, pp. 170-177), the total ginsenoside content should be not less than 1.5% using a spectrophotometric method of quantification. In contrast, the 4th Edition of the European Pharmacopoeia (European Pharmacopoeia Commission, European Directorate for the Quality of Medicines - Council of Europe, 2001) requires the content of ginsenosides R_{g1} and R_{b1} to be not less than 0.3%, measured using High Performance Liquid Chromatography (HPLC) methods. However, consumers in the U.S. who purchase a ginseng product should carefully consider the source and product. No federal agency enforces quality control over the ingredients of many products. In a study of 54 so-called ginseng products, it was found that 25% contained no ginsenosides at all, and 60% contained only trace amounts (8-10).

The principal physiological effects upon ingestion of ginseng that is documented in the older literature (2) include the following: general tonic; stimulation of immunological

function; beneficial effects on the cardiovascular system including a lowering of blood pressure; reductions in serum total cholesterol, low-density lipoprotein cholesterol and triglyceride levels and increases in serum high-density lipoprotein cholesterol levels; stimulation of alcohol dehydrogenase and oxidation of alcohol in the liver; lowering of blood sugar levels; stimulation of the pituitary-adrenocortical system, anti-aging, and inhibition of tumor growth. Interestingly, Rg1 is claimed to stimulate the central nervous system and enhance protein, DNA, and RNA synthesis whereas Rb1 has tranquilizing effects and improves memory which may again account for the different biological effects associated with the different species of *Panax* (6).

Recent experimental and clinical studies have demonstrated the following bioactive properties of the various chemicals and chemical fractions of the *Panax* species: powerful antioxidant activity (Rg1, Rb1, extract) (11-17); cardiovascular protection (Rg1, Rb1, extract) (11-21); immunological enhancement and anti-viral, anti-influenza (Rg1, polysaccharides, extract) (22-34); cytoprotection (polysaccharides, extract) (17, 20, 35); neuroprotection and anti-dementia (ginsenosides, Rb1, Rg2, Rg3, extract) (36-40); platelet aggregation inhibition (ginsenosides, Ro, Rg1, Rg2, polyacetylenes, extract) (41-44); calcium channel inhibition (Rf) (45); anti-cancer (Rg3, Rh2, polyacetylenes, polysaccharides) (46-52); anti-inflammatory (polyacetylenes, extract) (53, 54); anti-cholesterol (extract) (55, 56); hypoglycemic and anti-diabetes (polysaccharide, extract) (57-60); pulmonary disease protection and therapy (extract) (34, 61); hepatic protection and disease treatment (extract) (62, 63); enhancement of erectile capacity (extract) (64-67); enhanced memory and cognition (Rb1, Rg1, polyacetylenes, extract) (37, 38, 68, 69); and chronic fatigue (extract) (70, 71).

Presently available ginseng products are suspect regarding their chemical compositions not only with respect to the ginsenoside content but also with respect to crucial chemical constituents such as the essential oil and polysaccharides. What is needed are methods for extracting *Panax* and related species and *Panax* extraction compositions with enhanced bioactive profiles, such as, but not limited to, the triterpene saponins (e.g., ginsenosides), essential oil (e.g., polyacetylenes), and polysaccharides fractions, that can be produced with standardized and reliable amounts of these physiologically and medically beneficial bioactive *Panax* constituents.

SUMMARY OF INVENTION

In certain aspects the invention features novel compositions and pharmaceutical preparations of the same. In certain embodiments, the compositions comprise at least one ginsenoside in an amount greater than 10% by weight. The ginsenoside may comprise R₀, R₁, R₂, R_a, R_{b1}, R_{b2}, R_c, R_d, R_e, R_f, R_{g1}, R_{g2}, R_{g3}, R_{g5}, R_{h1}, R_{h2}, R_{h4}, R_{s1}, R_{s2}, R_{s3}, or R_{s4}. Certain compositions comprise at least one ginsenoside in an amount greater than 15, 20, 25, 30, 35, 40, 45 or 50% by weight.

Further embodiments feature compositions comprising a polyacetylene in an amount greater than 1, 2, 4, 6, 8, or 10% by weight. The polyacetylene may comprise pananaxynol, panaxydol, panaxytriol, acetylpanaxydol, chloropapaxydol, panaxydolchlorohydrin, panaxyne, ginsenoyne A, ginsenoyne B, ginsenoyne C, ginsenoyne D, ginsenoyne E, ginsenoyne F, ginsenoyne G, ginsenoyne H, ginsenoyne I, ginsenoyne J, or ginsenoyne K. In certain embodiments, the polyacetylene comprises pananaxynol, panaxydol, panaxytriol, acetylpanaxydol, chloropapaxydol, panaxydolchlorohydrin, panaxyne, ginsenoyne A, ginsenoyne B, ginsenoyne C, ginsenoyne D, ginsenoyne E, ginsenoyne F, ginsenoyne G, ginsenoyne H, ginsenoyne I, ginsenoyne J, and ginsenoyne K.

Further embodiments feature compositions comprising a polysaccharide in an amount greater than 25, 30, 35, 40, 45, 50, 55, or 60% by weight.. The polysaccharide may comprise glucose, arabinose, galactose, rhamnose, xylose or uronic acid.

Yet other embodiments feature compositions comprising an essential oil selected from the group consisting of (+)-spathulenol; (-)-spathulenol; caffeine; hexadecanoic acid; (-)-caryophyllene oxide; ethyl heptanoate; *trans,trans*-octadeca-9,12-dienoic acid methyl ester; octadec-9-ynoic acid methyl ester; phenylacetylene; ethylenethiourea; linoleic acid; 4-methyl-pent-2-enoic acid; 2-methyl-4-nitroimidazole; 9,12-octadecadienal; mevinphos; undec-10-ynoic acid; falcarinol ((Z)-1,9-heptadecadiene-4,6-diyn-3-ol); [1R-(1 α ,4 β ,4 α ,6 β ,8 α)]-octahydro-4,8a,9,9-tetramethyl-1,6-methano-1(2H)-naphthol; 4,6-diamino-1,3,5-triazin-2(1H)-one; 2,2'-methyliminodiethanol; dihydrouracil; stearic acid; 4-nitrophenol; 3-nitrotoluene; 2,3-dihydroxypropyl palmitate; oleic acid; cinnamyl acetate; 7-octenoic acid; 1-methyl-5-nitro-1H-imidazole; 2-ethyl-2-methyloxirane; methyl (9E,12E)-octadeca-9,12-dienoate; sinalbin, stigmasta-5,22-dien-3- β -ol; (3 β ,24S)-stigmast-5-en-3-ol; stigmast-5-en-3- β -ol; (3 β , 24 ξ)-stigmast-5-en-3-ol; 4-methyl-1,4-heptadiene; 9,12-octadecadienal; 7,8-epoxyoctene, 4-nonyne; 2-cyclopenten-1-undecanoic acid; 3-hydroxy-

2-methyl-4-pyrone; pyrogallol; [1aR-(1a α ,7 α ,7a α ,7b α)]-1a,2,3,5,6,7,7a,7b-octahydro-1,1,7,7a-tetramethyl-1H-cyclopropa[a]naphthalene; [1aR-(1a α ,4a α ,7 α ,7a β ,7b α)]-decahydro-1,1,7-trimethyl-4-methylene-1H-cycloprop[e]azulene; caryophyllene; 1R-(1R*,4Z,9S*)]-4,11,11-trimethyl-8-methylenebicyclo[7.2.0]undec-4-ene; 4-methyl-2-phenyl-2-pentenal; (Z)-9,17-octadecadienal; ethylidenecycloheptane; octa-1,7-diyne; 3-(phenylmethyl)sydnone; diisopropyl adipate; 2,3-dihydroxypropyl palmitate; 9Z,12Z-octadecadienoic acid (2-linoleoyl glycerol); and 3-ethenyl-cyclooctene.

Further embodiments feature compositions comprising at least one ginsenoside, polyacetylene, polysaccharide and/or essential oil of the minimum specified weight percents. In other embodiments, the compositions are formulated alone or in combination with other active ingredients into pharmaceutical formulations and/or foods.

The compositions of the present invention can be useful for providing certain physiological, psychological, and/or medicinal benefits upon ingestion, including, but not limited to, antioxidant activity, cardiovascular protection and treatment, cytoprotection, nervous system protection, anti-neurodegenerative disease (e.g., Alzheimer's disease, Parkinson's disease, stroke), platelet aggregation inhibition, anti-cholesterol, hypoglycemia and diabetes mellitus, anti-inflammatory, immune enhancement, anti-viral (e.g., influenza), anti-pulmonary disease, hepatic protection and disease treatment, cancer prophylaxis and therapy, enhancement of male erectile function, enhancement of memory and cognition, and relief from chronic fatigue syndromes.

In another aspect, the present invention features methods for treating a mammal (e.g. a human) for a disease or disorder, comprising administering to the mammal in need thereof a therapeutically effective amount of any of the aforementioned compositions.

In another aspect, the present invention relates to methods for extracting Panax compositions having a predetermined characteristic, such as, but not limited to, an elevated amount of a chemical constituent selected from the group consisting of: a triterpene saponin, polyacetylene, and/or polysaccharide. By elevated is meant an amount greater than the amount present in the native plant material or prior art Panax extraction products. In general, such methods comprise extraction of compounds, such as triterpene saponins, polyacetylenes, and polysaccharides from extracts of native Panax plant materials or from native Panax plant material using one or more extraction steps disclosed herein.

The various aspects and embodiments are further describe in the following detailed

description, drawings and claims.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 depicts an exemplary method for the preparation of an essential oil fraction from plant feedstock.

Figure 2 depicts an exemplary method for the preparation of ginsenoside fractions.

Figure 3 depicts an exemplary method for the preparation of a purified ginsenoside fraction using a polymer adsorbent.

Figure 4 depicts an exemplary method for the preparation of polysaccharide fractions.

Figure 5 depicts the chemical structure of 20(S)-ginsenoside R_{h1}, 20(S)-ginsenoside R_{h2}, 20(S)-ginsenoside R_{g3}, and ginsenoside R_{g5}.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

It must be noted that, as used in this specification and the appended claims, the singular forms “a”, “an”, and “the” include plural referents unless the context clearly dictates otherwise.

As used herein, the term “essential oil fraction” comprises compounds that are volatile, water-insoluble, and extractable using non-polar solvents. As used herein, the essential oil fraction further comprises polyacetylenes obtained from *Panax* and related species. The essential oil fraction may further comprise one or more compounds from sesquiterpenes, azulene, patchoulene, sesquiterpene alcohols, panasinsanol A, panasinsanol B, methoxypyrazine, β -elemene, diene panaxynols, or alkylpyrazines. The polyacetylenes of the essential oil fraction may further comprise one or more compounds from pananaxynol, panaxydiol, panaxytriol, acetylpanaxydol, panaxydolchlorohydrin, panaxyne, ginsenoyne A, ginsenoyne B, ginsenoyne C, ginsenoyne D, ginsenoyne E, ginsenoyne F, ginsenoyne G, ginsenoyne H, ginsenoyne I, ginsenoyne J, ginsenoyne K, panaxacol, panaxydol, falcarinol or falcarintriol.

As used herein, the term “feedstock” refers to raw plant material, comprising whole plants alone, or in combination with one or more constituent parts of a plant comprising leaves, rhizomes, roots, including, but not limited to, main roots, tail roots, and fiber roots, stems, leaves, seeds, and flowers, wherein the plant or constituent parts may comprise material that is raw, dried, steamed, heated or otherwise subjected to physical processing to facilitate processing, which may further comprise material that is intact, chopped, diced, milled or otherwise processed to affected the size and physical integrity of the plant material.

As used herein, the term “fraction” means a composition comprising a specific group of compounds characterized by certain physical, chemical properties, or physical and chemical properties.

As used herein, the term “ginseng constituents” shall mean compounds found in each of the individual *Panax* and related species and shall include all such chemicals compounds identified above as well as other compounds found in each *Panax* and related species, including but not limited to essential oils, polyacetylenes, ginsenosides, and polysaccharides.

As used herein, the term “ginsenoside fraction” comprises triterpene saponins obtained from *Panax* and related species, further comprising compounds based on the protopanaxadiol backbone, the protopanaxtriol backbone, the ocotillol backbone, or the oleanane backbone, and related compounds.

As used herein, the term “increased” or “elevated” amount of a fraction, including, but not limited to, fractions such as the triterpene saponin, polyacetylene, and polysaccharide fractions, means that the weight percent of the fraction, either *in toto* or a single constituent of the fraction, in a mixture or sample is increased compared to the weight percent of the constituent or fraction in the native plant or plant tissue.

As used herein, the term “one or more compounds” means that at least one compound, such as panaxytriol (an essential oil polyacetylene), R_{g1} (a ginsenoside triterpene saponin), or ginsenan PA (a water soluble ginseng polysaccharide) is intended, or that more than one compound, for example, panaxytriol and R_{g1} is intended. As known in the art, the term “compound” does not mean a single molecule, but multiples or moles of molecules. As known in the art, the term “compound” means a specific chemical entity possessing distinct chemical and physical properties, whereas “compounds” refer to one or

more chemical constituents.

As used herein, the term “Panax” comprises the genus *Panax* and related species, including, but not limited to, *Eleutherococcus senticosus*. Further, as used herein, *Panax* refers to the plant or plant material derived from the plant *Araliaceae* family, wherein the species includes but is not limited to, *P. ginseng*, *P. quinquefolius*, *P. notoginseng*, *P. pseudoginseng*, *P. japonicum*, *P. vietnamensis*, and *E. senticosus*. The term also includes all clones, cultivars, variants, and sports of *Panax* and related species. The term “Panax” may also be used herein interchangeably with “ginseng” and means these plants, clones, cultivars, variants, and sports.

As used herein, the term “polysaccharide fraction” comprises compounds obtained or derived from *Panax* and related species. The polysaccharide extract fraction of the chemical constituents of the *Panax* species has been defined in the scientific literature as the “ethanol insoluble-water soluble extraction fraction” (26, 31, 63, 72-74). The polysaccharide fraction may comprise one or more compounds from ginsan and panaxans A through U, including, but not limited to, the neutral polysaccharides panaxans A through E and the acidic polysaccharides panaxan Q through U. The polysaccharide fraction may further comprise saccharide polymers and oligomers comprising monomer units from glucose, arabinose, galactose, rhamnose, xylose, or uronic acid.

As used herein, the term “rhizome” refers to the constituent part of *Panax* and related species comprising a horizontal root stem, which may be in part or in whole, underground, further comprising shoots above and roots below, including, but not limited to, main roots, tail roots, and fiber roots.

Compositions

The compositions of the present invention comprise extract fractions from *Panax* comprising high levels of ginsenosides which may further comprise a polyacetylene, a polysaccharide, or both.

The prior art *Panax* species extraction products contain variable native plant materials. For example, widely fluctuating amounts of only ginsenosides, if any, are present. In contrast, the present compositions comprise defined amounts of isolated and purified fractions of essential oils, ginsenosides and polysaccharides from one or more *Panax* species. These individual fraction compositions can be combined in specific ratios (profiles) to provide beneficial combination compositions and can provide extract products

that are not found in currently known extract products. For example, an essential oil fraction from one species may be combined with a ginsenosides fraction from the same or different species, and that combination composition may or may not be combined with a polysaccharide fraction from a same or different species of *Panax*.

Tables 1 through 4 list the principal beneficial bioactive chemical constituent fractions found in the four major *Panax* species rhizome feedstocks used to produce ginseng products.

Table 1. Chemical Constituent Fractions of *Panax notoginseng* Rhizome*

Constituents (Source)	Essential Oil Fraction	Ginsenoside Fraction	Polysaccharide Fraction
Literature	0.045-0.056	8.6-9.1	-
ARS-PED**	-	8.7	-
HS Lab***	0.3-0.5	12.0	47.0

*% mass dry weight = (mass weight of fraction/mass weight of feedstock).

**USDA Agricultural Research Service.

***HerbalScience Laboratory.

Table 2. Chemical Constituent Fractions of American Ginseng (*Panax quinquefolius* L. Rhizome)

Constituents (Source)	Essential Oil Fraction	Ginsenoside Fraction	Polysaccharide Fraction
Literature	-	5-6	-
ARS-PED	-	2.4	4-20
HS Lab	0.1-0.3	2.3	18

Table 3. Chemical Constituent Fractions of White Ginseng (*Panax ginseng* C. Rhizome)

Constituents (Source)	Essential Oil Fraction	Ginsenoside Fraction	Polysaccharide Fraction
Literature	-	2.5-3	-
ARS-PED	-	4.7	22
HS Lab	0.5	3.2	17.4

Table 4. Chemical Constituent Fractions of Red Ginseng (*Panax ginseng* C. Rhizome)

Constituents (Source)	Essential Oil Fraction	Ginsenoside Fraction	Polysaccharide Fraction
Literature	-	1.5-2.8	-
ARS-PED	-	-	-
HS Lab	0.5	1.84	26.13

The compositions of *Panax* and related species described herein have ginsenosides in amounts greater than that found in the native *Panax* and related species plant material or currently available *Panax* species extract products. Importantly, natural *Panax* and related species have low amounts of key ingredient ginsenosides (8.6-91% by weight at most). Commercially available products comprise ~3% ginsenosides by weight reflecting the difficulty in isolating *Panax* ingredients that presently exists. Embodiments also comprise compositions wherein one or more of the fractions, including essential oils, ginsenosides, or polysaccharides, are found in a concentration that is greater than that found in native *Panax* species plant material. Embodiments also comprise compositions wherein one or more of the fractions, including essential oils, ginsenosides, or polysaccharides, are found in a concentration that is less than that found in native *Panax* species. Known amounts of four *Panax* species are shown here in Tables 1-4. For example, compositions of the present invention comprise compositions where the concentration of essential oils is from 0.001 to 200 times the concentration of native *Panax* species, and/or compositions where the concentration of ginsenosides is from 0.001 to 100 times the concentration of native *Panax* species, and/or compositions where the concentration of polysaccharides is from 0.01 to 6 times the concentration of native *Panax* species. Compositions of the present invention comprise compositions where the concentration of essential oils is from 0.1 to 50 times the concentration of native *Panax* species, and/or compositions where the concentration of ginsenosides is from 0.1 to 50 times the concentration of native *Panax* species, and/or compositions where the concentration of polysaccharides is from 0.01 to 6 times the concentration of native *Panax* species.

Panax species compositions for antioxidant activity and cardiovascular protection may have an increased ginsenoside fraction composition concentration, a reduced essential oil fraction composition concentration, and an increased polysaccharide fraction composition concentration, by % weight, than that found in the *Panax* species native plant material or conventional known extraction products. A novel *Panax* species composition

for immune enhancement may have an increased ginsenoside fraction composition and a polysaccharide fraction composition, and a reduced essential oil fraction composition concentration, by % weight, than that found in the native *Panax* species plant material or conventional known extraction products. Another example of a novel *Panax* species composition, for treatment of Alzheimers disease, dementia, and enhancement of memory and cognition, comprises a composition having an increased essential oil fraction composition concentration and a ginsenoside fraction composition, and a reduced polysaccharide fraction composition than that found in native *Panax* species plant material or known conventional extraction products. Additional embodiments comprise compositions comprising altered profiles (ratio distribution) of the chemical constituents of the *Panax* species in relation to that found in the native plant material or to currently available *Panax* species extract products. For example, the essential oil fraction may be increased or decreased in relation to the ginsenoside and/or polysaccharide concentrations. Similarly, the ginsenosides or polysaccharides may be increased or decreased in relation to the other extract constituent fractions to permit novel constituent chemical profile compositions for specific biological effects.

Methods of Extractions

The starting material for extraction is plant material from one or more *Panax* species, though *P. notoginseng*, *P. ginseng*, which may either be in the form commonly known as “white ginseng” or the form commonly known as “red ginseng”, or *P. quinquefolius* are the preferred starting materials. As used herein, “white ginseng” comprises the material derived from *P. ginseng* which has dried in open air or in a dryer following harvesting such that the color does not become red to brown in color. As used herein, “red ginseng” comprises material derived from *P. ginseng* which has been heated, typically by steaming, and then dried in a manner such that the material becomes red to brown in color. The material may be the aerial portion of the plant, which includes the leaves, stems, or other plant parts, though the rhizome is the preferred starting material.

The *Panax* species plant material may undergo pre-extraction steps to render the material into any particular form, and any form that is useful for extraction is contemplated by the present invention. Such pre-extraction steps include, but are not limited to, material which is chopped, minced, shredded, ground, pulverized, cut, or torn, and the starting material, prior to pre-extraction steps, is dried or fresh plant material. A preferred pre-extraction step comprises grinding and/or pulverizing the *Panax* species rhizome material

into a fine powder. The starting material or material after the pre-extraction steps can be dried or have moisture added to it. Once the Panax species plant material is in a form for extraction, methods of extraction are contemplated by the present invention.

Methods of extraction of the present invention comprise processes disclosed herein. In general, methods of the present invention comprise, in part, methods wherein Panax species plant material is extracted using supercritical carbon dioxide (SCCO₂) that is followed by one or more solvent extraction steps, such as, but not limited to, water, hydroalcoholic, and polymer absorbent extraction processes. Additional methods contemplated for the present invention comprise extraction of Panax species plant material using other organic solvents, refrigerant chemicals, compressible gases, sonification, pressure liquid extraction, high speed counter current chromatography, molecular imprinted polymers, and other known extraction methods. Such techniques are known to those skilled in the art. In one aspect, compositions of the present invention may be prepared by a method comprising the steps depicted schematically in Figs. 1, 2, 3, and 4.

Supercritical Fluid Extraction of Panax

Due to the hydrophobic nature of the essential oil, non-polar solvents, including, but not limited to SCCO₂, hexane, petroleum ether, and ethyl acetate may be used for this extraction process.

A generalized description of the extraction of the essential oil fraction from the rhizome of the Panax species using SCCO₂ is diagrammed in Figure 1. The feedstock **10** is ground Panax species rhizome (8 to 20 mesh). The solvent **210** is pure CO₂. The feedstock is loaded into a basket that is placed inside a supercritical fluid extraction (SFE) vessel **20**. After purge and leak testing, the process comprises liquefied CO₂ flowing from a storage vessel through a cooler to the CO₂ pump. Then the CO₂ is compressed to the desired pressure flows through the feedstock in the extraction vessel where the pressure and temperature are maintained at the desired levels. The pressures for extraction range from about 100 to about 800 bar, from about 200 to about 600, from about 300 to about 400 bar, and the temperatures range from about 50° C to about 120° C, and from about 60° C to about 100° C, and from about 80° C to about 90° C. The time for extraction range from about 30 minutes to about 2.5 hours, from about 1 hour to about 2 hours, to about 1.5 hours. The solvent to feed ratio is typically 17-18 to 1 for each of the SCCO₂ extractions. The extracted and purified essential oil fraction is then collected in a collector vessel **30**, saved

and stored in a dark refrigerator to 5° C. The CO₂ is recycled. The Panax species feedstock residue 40 is also collected from the extraction vessel, saved and used for further extractions of the chemical constituents in the Panax species rhizome. Typically, the total yield of essential oil fractions from Panax species varies from 0.2% to 0.05% mass dry weight of the original feedstock having an essential oil fraction chemical constituent composition of essentially 100% purity. The purity is measured using HPLC and GC-MS analysis (see Examples 1-4).

Ginsenoside Extraction Process

In one aspect, the present invention comprises extraction and concentration of the ginsenosides or triterpene saponins. A generalized description of this extraction step is diagrammed in Figure 2. This ginsenoside extraction process is a 3 stage solvent leaching process. The feedstock for this ginsenoside process is the residue 40 or 45 following extraction of the essential oil fraction. The extraction solvent 220, 230, 240 is typically 63% ethanol in water. In this method, the Panax species residue and the extraction solvent are loaded into an extraction vessel heated. 50 It may be heated to less than 100° C, to about 90° C, 80° C, or to about 50-60 °C. The extraction is carried out for about 1-4 hours, for about 3 hours, for about 2 hours. The resultant fluid extract is filtered 60. The filtrate is collected as product 310, measured for volume and solid content dry mass weight after evaporation of the solvent. The extraction residue 70 material retained by the filter. The extraction may be repeated as many times as is necessary or desired. It may be repeated 2 or more times, 3 or more times, four or more times, etc. For example, Figure 2 shows a three stage process, where the second stage 80 and the third stage 110 uses the same methods and conditions. Examples are seen in Examples 5 through 8 and Tables 5 through Table 8, respectively.

Although over 30 individual ginsenoside compounds have been detected and characterized in the genus Panax, the majority of these exist in only trace amounts. The seven ginsenosides (Rg1, Re, Rf, Rb1, Rc, Rb2, Rd) that account for greater than 95% of the total ginsenoside content of the Panax species are measured throughout the extraction processes using HPLC analysis permitting computation of the % dry weight of the individual and total ginsenoside content in the extract products (Tables 5 to 20). The HPLC analysis was accomplished using a Shimadzu SE0405003 HPLC with analytical reference standards obtained from Chromadex, KIT-00007226-005 (ginsenosides standard kit) (see

Examples 22-25).

As shown in Tables 5 through 12, a two stage solvent leaching process can give a total ginsenoside yield of at least 96% for each of the four *Panax* species used as a feedstocks studied while simultaneously increasing the purity of the ginsenosides in the ginsenoside extract fraction at least 4-fold. In the particular case of *P. notogensing*, the ginsenoside concentration of the feedstock was 12.26% mass weight and the ginsenoside concentration in the ginsenoside fraction from recombination of the stage I and stage II extractions was 50.5% by dry weight, thus a 5 fold increase in the ginsenoside concentration. For *P. quinquefolius*, the ginsenoside concentration in the feedstock was 2.32% mass weight and the concentration in the two stage leaching ginsenoside extract fraction was 15.2%, thus a 6 fold increase in ginsenoside concentration. For White ginseng (*P. ginseng*), the ginsenoside concentration in the feedstock was 3.19% and the concentration in the two stage leaching ginsenoside extract fraction was 8.9%, thus a 3 fold increase in ginsenoside concentration. Finally, for Red ginseng (*P. ginseng*), the ginsenoside concentration in the feedstock was 1.84% and the concentration in the two stage leaching ginsenoside extract fraction was 4.6%, thus a 2.6 fold increase in total ginsenoside concentration. Furthermore, the concentration distribution or profile of the individual ginsenosides within the extract fraction obtained from the two stage solvent leaching method is well preserved relative to the ginsenoside profile found in each of the original feedstock material. In conclusion, a two stage solvent leaching process is a very efficient and cost effective method for the extraction of the highly purified ginsenoside fraction from the plant material of the *Panax* species.

Polymer Adsorbent Purification of Ginsenosides

A purified ginsenoside extract from the *Panax* species feedstock may be obtained by contacting an aqueous extract of a ginseng feedstock is with a solid polymer affinity adsorbent resin to adsorb the active ginsenosides contained in the aqueous extract onto the adsorbent resin. The bound ginsenosides are then eluted by methods taught herein. Prior to eluting the ginsenosides, the polymer adsorbent resin with the ginsenosides adsorbed thereon may be separated from the remainder of the extract in any convenient manner, preferably, passing the extract through a column containing the resin.

A variety of polymer adsorbent resins can be used to purify the ginsenosides, including , but not limited to, Amberlite XAD-2 (Rohm and Hass), Duolite S-30 (Diamond

Alkai Co.), or ADS-8 (Nankai University, Tianjin, China). ADS-8 has high affinity for the triterpene saponin ginsenosides. The ADS-8 resin beads, particle size 0.5-0.6 mm, are a polystyrene copolymer with an ester group. It is believed that the polystyrene adsorbs chemical compounds by hydrophobic interactions between the highly hydrophobic surface of the polystyrene and the hydrophobic sites or sorbates. Ester groups are used for adsorption of chemicals by hydrogen bonding interactions. These two interactions work together to achieve a high selectivity for bonding of the triterpene saponin ginsenosides. Since hydrophobic interaction is one of the driving forces in this separation, an aqueous solution free of alcohol is the solvent used to contain the chemical constituents that are to be adsorbed. An alcohol is then used as the de-adsorption agent.

Although various eluants may be employed to recover the ginsenosides from the polymer adsorbent resin, in one aspect of the present invention, the eluant comprises a low molecular weight alcohol, including, but not limited to, methanol, ethanol, or propanol. In a second aspect, the eluant comprises a low molecular weight alcohol and water. In another aspect, the eluant comprises a low molecular alcohol in an admixture with another organic solvent. In a further aspect, the eluant comprises a low molecular weight alcohol, a second organic solvent, and water.

The *Panax* species feedstock may have undergone one or more preliminary processes including, but not limited to, the processes for removing essential oils or solvent leaching steps, shown in Figures 1 and 2, prior to contacting the aqueous ginsenoside containing extract with the polymer adsorbent resin.

Using polymer adsorbent resins as taught in the present invention results in highly purified ginsenoside extracts of the *Panax* species that are free of other chemical constituents which are normally present in natural plant material or in available commercial extraction products. For example, the processes taught in the present invention can result in purified ginsenoside extracts that contain total ginsenosides in excess of 90% by dry mass weight. Using the methods taught herein, it is possible to achieve a purified ginsenoside extract fraction of greater than 95% as measured by % mass.

A generalized description of the extraction and purification of the ginsenosides from the rhizome of the *Panax* species using polymer affinity adsorbent resin beads is diagrammed in Figure 3. The feedstock for this extraction process may be the hydroalcoholic solutions containing the ginsenosides from Figure 2, 310, 320, 330. The

alcohol is evaporated from this solution 420 and then diluted with distilled water 260 to the original volume to keep the triterpene saponin concentration in this aqueous solution unchanged 420. The appropriate weight of adsorbent resin beads (50-75 mg of ginsenosides per gram of adsorbent resin) is washed with water and ethanol before and after being loaded into a column. The ginsenoside containing aqueous solution 430 is then loaded onto the column 470 at a flow rate of 2 to 4 bed volume/hour. Once the column is fully loaded, the column is washed with water 280 at a flow rate of 50 ml/hour to remove any impurities from the adsorbed ginsenosides 480. Elution of the adsorbed ginsenosides 490 is accomplished with ethanol/water (4/1) as an eluting solution 290 at a flow rate of 50 ml/hour and the elution curve recorded for the extract. The eluate 500 consisting of the purified ginsenoside fraction was analyzed using HPLC. Result from individual experiments can be found in Examples 22 through 25 and Tables 13 through 20.

Polysaccharide Extraction Process

A generalized description of the extraction of the polysaccharide fraction from the rhizome of the Panax species using water solvent leaching and ethanol precipitation processes is diagramed in Figure 4. The feedstock 70, 100, 130 is the residue from the solvent leaching extraction of the ginsenoside (Figure 2). The solvent is distilled water 250, 260, 270. The residue feedstock may be extracted multiple times in hot aqueous solutions, for example, water, at approximately 100° C, for at least one hour, for at least two hours, for at least three hours, in an extraction vessel. Figure 4 shows 3 extractions three times with water at approximately 100° C. The amount of water is generally the same for the first extractions and less for the last extractions. For example, the volume of water for the first extraction 610 and second extraction 640 was 15 ml/gm of feedstock residue and for the third extraction 670 was 10 ml/gm of feedstock residue. After each stage of boiling water leaching the resulting fluid extract is filtered 620, 650, 680. The filtrate is collected as product 710, 720, 730 and measured for volume and solid content (dry mass weight). The extraction residue material retained by the filter in the first stage 260 and then may be used as a feedstock for the second stage of extraction using the same methods, and the process may be repeated in a third stage 670. The residue 690 after the third stage is discarded. Interestingly, the extraction products 710, 720, 730 can be shown to be highly purified polysaccharides (about 99% pure Panax species water soluble, ethanol insoluble polysaccharides) based on a variety of tests which are discussed in Example 30.

The various extract fractions are dried and stored separately for later recombination into a wide variety of nutraceutical and pharmaceutical formulations derived from Panax species extraction products.

Many methods are known in the art for removal of alcohol from solution. If it is desired to keep the alcohol for recycling, the alcohol can be removed from the solutions, after extraction, by distillation under normal or reduced atmospheric pressures. The alcohol can be reused. Furthermore, there are also many methods known in the art for removal of water from solutions, either aqueous solutions or solutions from which alcohol was removed. Such methods include, but not limited to, spray drying the aqueous solutions onto a suitable carrier such as, but not limited to, magnesium carbonate or maltodextrin, or alternatively, the liquid can be taken to dryness by freeze drying or refractive window drying.

In performing the previously described extraction methods, it was found that greater than 80% yield by mass weight of the essential oil in the original dried rhizome feedstock of the Panax species can be extracted in the essential oil extract fraction (Step 1). Using the methods of shown in Figure 2 greater than 98% yield by mass weight of the ginsenoside chemical constituents of the original dried rhizome feedstock of the Panax species can be extracted in the ginsenoside extract fraction. Furthermore, it appears that greater than 99% by weight of the polysaccharide constituents of the original dried rhizome feedstock of the Panax species can be extracted in the polysaccharide fraction. Finally, the methods as taught in the present invention permit the purification (concentration) of the essential oil fraction, ginsenoside fraction, and the polysaccharide fraction to be as high as 99% of the desired chemical constituents (essentially all of the essential oil, triterpene saponin, and polysaccharide chemical constituents present in the original Panax species plant material). The specific extraction environments, rates of extraction, solvents, and extraction technology used often are adjusted depending on the starting chemical constituent profile of the source material and the level of purification desired in the final extraction products. Specific methods as taught in the present invention can be readily adjusted by those skilled in the art using no more than routine experimentation typical for adjusting a process to account for sample variations in starting materials. For example, in a particular lot of P. ginseng (White Ginseng), the initial concentrations of the essential oil, the ginsenosides, and the polysaccharides are determined using methods known to those skilled in the art. One skilled in the art can determine the amount of change from the initial concentration of

the ginsenosides, for instance, to the predetermined amounts of ginsenosides for the final extraction product using the extraction methods, as disclosed herein, to reach the desired concentration in the final *P. ginseng* composition product.

Pharmaceutical Compositions

According to a further aspect of the invention, the novel extracted *Panax* species plant material or a novel *Panax* species extract composition can be further processed to dry, flowable powder. The powder can be used as a dietary supplement that can be added to various edible products. The powder or the final predetermined unique extract compositions of the *Panax* species are also suitable for use in a rapid dissolve tablet.

According to a particular aspect of the present invention, the extracted *Panax* species compositions are produced to have a predetermined essential oil, ginsenoside, and polysaccharide concentrations that are greater than that found in the natural plant material or conventional *Panax* species extract products and/or predetermined novel profiles of the three major bioactive chemical constituents of the *Panax* species, wherein the ratios (profiles) of the amounts (% dry weight) of essential oil/ginsenoside and/or essential oil/polysaccharide and/or ginsenoside/polysaccharide are greater or less than the chemical constituent profiles found in the natural *Panax* species plant material or known *Panax* species extraction products. Such compositions are particularly well suited for delivery in the oral cavity of human subjects, e.g., via a rapid dissolve tablet.

In one embodiment of a method for producing a *Panax* species extraction powder, a dry extracted *Panax* species composition is mixed with a suitable solvent, such as but not limited to water or ethyl alcohol, along with a suitable food-grade material using a high shear mixer and then spray air-dried using conventional techniques to produce a powder having grains of very small *Panax* species extract particles combined with a food-grade carrier.

In a particular example, an extracted *Panax* species composition is mixed with about twice its weight of a food-grade carrier such as maltodextrin having a particle size of between 100 to about 150 micrometers and an ethyl alcohol solvent using a high shear mixer. Inert carriers, such as silica, preferably having an average particle size on the order of about 1 to about 50 micrometers, can be added to improve the flow of the final powder that is formed. Preferably, such additions are up to 2 % by weight of the mixture. The amount of ethyl alcohol used is preferably the minimum needed to form a solution with a

viscosity appropriate for spray air-drying. Typical amounts are in the range of between about 5 to about 10 liters per kilogram of extracted Panax species material. The solution of extracted Panax species composition, maltodextrin and ethyl alcohol is spray air-dried to generate a powder with an average particle size comparable to that of the starting carrier material.

In a second embodiment, an extracted Panax species composition and food-grade carrier, such as magnesium carbonate, a whey protein, or maltodextrin are dry mixed, followed by mixing in a high shear mixer containing a suitable solvent, such as water or ethyl alcohol. The mixture is then dried via freeze drying or refractive window drying. In a particular example, extracted Panax species composition material is combined with food grade material about one and one-half times by weight of the extracted Panax species composition, such as magnesium carbonate having an average particle size of about 20 to 200 micrometers. Inert carriers such as silica having an particle size of about 1 to about 50 micrometers can be added, preferably in an amount up to 2% by weight of the mixture, to improve the flow of the mixture. The magnesium carbonate and silica are then dry mixed in a high speed mixer, similar to a food processor-type of mixer, operating at 100's of rpm. The extracted Panax species composition material is then heated until it flows like a heavy oil. Preferably, it is heated to about 50° C. The heated extracted Panax species composition is then added to the magnesium carbonate and silica powder mixture that is being mixed in the high shear mixer. The mixing is continued preferably until the particle sizes are in the range of between about 250 micrometers to about 1 millimeter. Between about 2 to about 10 liters of cold water (preferably at about 4° C) per kilogram of extracted Panax species composition material is introduced into a high shear mixer. The mixture of extracted Panax species composition, magnesium carbonate, and silica is introduced slowly or incrementally into the high shear mixer while mixing. An emulsifying agent such as carboxymethylcellulose or lecithin can also be added to the mixture if needed. Sweetening agents such as Sucralose or Acesulfame K up to about 5 % by weight can also be added at this stage if desired. Alternatively, extract of *Stevia rebaudiana*, a very sweet-tasting dietary supplement, can be added instead of or in conjunction with a specific sweetening agent (for simplicity, *Stevia* will be referred to herein as a sweetening agent). After mixing is completed, the mixture is dried using freeze-drying or refractive window drying. The resulting dry flowable powder of extracted Panax species composition material, magnesium carbonate, silica and optional emulsifying agent and optional sweetener has an average

particle size comparable to that of the starting carrier and a predetermined extraction Panax species composition.

According to another embodiment, an extracted Panax species composition material is combined with approximately an equal weight of food-grade carrier such as whey protein, preferably having a particle size of between about 200 to about 1000 micrometers. Inert carriers such as silica having a particle size of between about 1 to about 50 micrometers, or carboxymethylcellulose having a particle size of between about 10 to about 100 micrometers can be added to improve the flow of the mixture. Preferably, an inert carrier addition is no more than about 2 % by weight of the mixture. The whey protein and inert ingredient are then dry mixed in a food processor-type of mixer that operates over 100 rpm. The Panax species extraction composition material is heated until it flows like a heavy oil (preferably heated to 50° C). The heated Panax species extraction composition is then added incrementally to the whey protein and inert carrier that is being mixed in the food processor-type mixer. The mixing of the Panax species extraction composition and the whey protein and inert carrier is continued until the particle sizes are in the range of about 250 micrometers to about 1 millimeter. Next, 2 to 10 liters of cold water (preferably at about 4° C) per kilogram of the paste mixture is introduced in a high shear mixer. The mixture of Panax species extraction composition, whey protein, and inert carrier is introduced incrementally into the cold water containing high shear mixer while mixing. Sweetening agents or other taste additives of up to 5 % by weight can be added at this stage if desired. After mixing is completed, the mixture is dried using freeze drying or refractive window drying. The resulting dry flowable powder of Panax species extraction composition, whey protein, inert carrier and optional sweetener has a particle size of about 150 to about 700 micrometers and an unique predetermined Panax species extraction composition.

In a further embodiment, a predetermined Panax species extraction composition is dissolved in a SFE CO₂ fluid which is then absorbed onto a suitable food-grade carrier such as maltodextrin, dextrose, or starch. Preferably, the SFE CO₂ is used as the solvent. Specific examples include starting with a novel extracted Panax species composition and adding from one to one and a half times the extracted Panax species material by weight of the food-grade carrier having a particle size of between about 100 to about 150 micrometers. This mixture is placed into a chamber containing mixing paddles and which can be pressurized and heated. The chamber is pressurized with CO₂ to a pressure in the

range between 1100 psi to about 8000 psi and set at a temperature in the range of between about 20° C to about 100° C. The exact pressure and temperature are selected to place the CO₂ in a supercritical fluid state. Once the CO₂ in the chamber is in the supercritical state, the Panax species extraction composition is dissolved. The mixing paddles agitate the carrier powder so that it has intimate contact with the supercritical CO₂ that contains the dissolved Panax species extract material. The mixture of supercritical CO₂, dissolved Panax species extraction material, and the carrier powder is then vented through an orifice in the chamber which is at a pressure and temperature that does not support the supercritical state for the CO₂. The CO₂ is thus dissipated as a gas. The resulting powder in the collection vessel is the carrier powder impregnated with the predetermined novel Panax species extraction composition. The powder has an average particle size comparable to that of the starting carrier material. The resulting powder is dry and flowable. If needed, the flow characteristics can be improved by adding inert ingredients to the starting carrier powder such as silica up to about 2 % by weight as previously discussed.

In the embodiments where the extract composition of the Panax species with a predetermined composition or profile is to be included into a oral fast dissolve tablet as described in U.S. Patent 5,298,261, the unique extract can be used “neat”, that is, without any additional components which are added later in the tablet forming process as described in the patent cited. This method, then obviates the necessity to take the unique Panax species extract composition to a dry flowable powder that is then used to make the tablet.

Once a dry Panax species extraction composition powder is obtained, such as by the methods discussed herein, it can be distributed for use, e.g., as a dietary supplement or for other uses. In a particular embodiment, the novel Panax species extraction composition powder is mixed with other ingredients to form a tableting composition of powder which can be formed into tablets. The tableting powder is first wet with a solvent comprising alcohol, alcohol and water, or other suitable solvents in an amount sufficient to form a thick doughy consistency. Suitable alcohols include, but not limited to, ethyl alcohol, isopropyl alcohol, denatured ethyl alcohol containing isopropyl alcohol, acetone, and denatured ethyl alcohol containing acetone. The resulting paste is then pressed into a tablet mold. An automated tablet molding system, such as described in U.S. Patent No. 5,407,339, can be used. The tablets can then be removed from the mold and dried, preferably by air-drying for at least several hours at a temperature high enough to drive off the solvent used to wet the tableting powder mixture, typically between about 70° C to about 85° C. The dried

tablet can then be packaged for distribution.

Methods and compositions of the present invention comprise compositions comprising unique *Panax* specie extract compositions in the form of a paste, resin, oil, or powder. An aspect of the present invention comprises compositions of liquid preparations of unique *Panax* species extract compositions. Liquid preparations for oral administration may take the form of, for example, solutions, syrups or suspensions, or they may be presented as a dry product for reconstitution with water or other suitable vehicle prior to administration. Such liquid preparations may be prepared by conventional means with pharmaceutically acceptable additives such as suspending agents (e.g., sorbitol syrup, methyl cellulose, or hydrogenated edible fats); emulsifying agents (e.g., lecithin or acacia); non-aqueous vehicles (e.g., almond oil, oily esters or ethyl alcohol); preservatives (e.g., methyl or propyl p-hydroxybenzoates or sorbic acid); and artificial or natural colors and/or sweeteners. Compositions of the liquid preparations can be administered to humans or animals in pharmaceutical carriers known to those skilled in the art. Such pharmaceutical carriers include, but are not limited to, capsules, lozenges, syrups, sprays, rinses, and mouthwash.

An aspect of the present invention comprises compositions of a dry powder *Panax* species extraction composition. Such dry powder compositions may be prepared according to methods disclosed herein and by other methods known to those skilled in the art such as, but not limited to, spray air drying, freeze drying, vacuum drying, and refractive window drying. The combined dry powder compositions can be incorporated into a pharmaceutical carrier such, but not limited to, tablets or capsules, or reconstituted in a beverage such as a tea.

Although the extraction techniques described herein are discussed in terms of *Panax* species, it should be recognized that compositions of the present invention can also comprise, in the form of a dry flowable powder or other forms, extracts from other plants such as, but not limited to, varieties of turmeric, boswellia, guarana, cherry, lettuce, Echinacia, piper betel leaf, Areca catechu, muira puama, ginger, willow, suma, kava, horny goat weed, ginko bilboa, mate', garlic, puncture vine, arctic root astragalus, eucommia, gastropodia, and uncaria, or pharmaceutical or nutraceutical agents.

The present invention comprises compositions comprising unique *Panax* species extract compositions in tablet formulations and methods for making such tablets. A

tableting powder can be formed by adding about 1 % to 40 % by weight of the powdered Panax species extract composition, with between 30 % to about 80 % by weight of a dry water-dispersible absorbant such as, but not limited to, lactose. Other dry additives such as, but not limited to, one or more sweetener, flavoring and/or coloring agents, a binder such as acacia or gum arabic, a lubricant, a disintegrant, and a buffer can also be added to the tableting powder. The dry ingredients are screened to a particle size of between about 50 to about 150 mesh. Preferably, the dry ingredients are screened to a particle size of between about 80 to 100 mesh.

The present invention comprises compositions comprising tablet formulations and methods for making such tablets. Preferably, the tablet has a formulation that results in a rapid dissolution or disintegration in the oral cavity. The tablet is preferably a homogeneous composition that dissolves or disintegrates rapidly in the oral cavity to release the extract content over a period of about 2 seconds or less than 60 seconds or more, preferably about 3 to about 45 seconds, and most preferably between about 5 to about 15 seconds.

Various rapid-dissolve tablet formulations known in the art can be used. Representative formulations are disclosed in U.S. Patent Nos. 5,464,632; 6,106,861; 6,221,392; 5,298,261; 6,221,392; and 6,200,604; the entire contents of each are expressly incorporated by reference herein. For example, U.S. Patent No. 5,298,261 teaches a freeze-drying process. This process involves the use of freezing and then drying under a vacuum to remove water by sublimation. Preferred ingredients include hydroxyethylcellulose, such as Natrosol from Hercules Chemical Company, added to between 0.1 % and 1.5 %. Additional components include maltodextrin (Maltrin, M-500) at between 1 % and 5 %. These amounts are solubilized in water and used as a starting mixture to which is added the Panax species extraction composition, along with flavors, sweeteners such as Sucralose or Acesulfame K, and emulsifiers such as BeFlora and BeFloraPlus which are extracts of mung bean.

A particularly preferred tableting composition or powder contains about 10 % to 60 % by of the Panax species extract composition powder and about 30 % to about 60 % of a water-soluble diluent. Suitable diluents include lactose, dextrose, sucrose, mannitol, and other similar compositions. Lactose is a preferred diluent but mannitol adds a pleasant, cooling sensation and additional sweetness in the mouth. More than one diluent can be used.

A sweetener may also be included, preferably in an amount between 3 % to about 40 % by weight depending on the desired sweetness. Preferred sweetening substances include sugar, saccharin, sodium cyclamate, aspartame, and Stevia extract used singly or in combination, although other sweeteners could alternatively be used. Flavoring such as mint, cinnamon, citrus (e.g., lemon or orange), mocha, and others can be also included, preferably in an amount between about 0.001 % to about 1 % by weight.

A coloring may also be added, including natural and/or synthetic colors which are known in the art as safe and acceptable for use in drug or food products. Coloring, if added, may be added in an amount of between about 0.5 % to about 2 % by weight.

Typically, this tableting composition will maintain its form without the use of a binder. However, if needed, various binders are suitable and can be added in an amount of between about 5 % to about 15 % or as necessary. Preferred binders are acacia or gum arabic. Alternative binders include sodium alginate, extract of Irish moss, panwar gum, ghatti gum, mucilage of isapol husks, carboxymethylcellulose, hydroxyethylcellulose, methylcellulose, polyvinylpyrrolidone, VEEGUM® (R. T. Vanderbilt Co., Inc., Norwalk, Conn.), larch arabogalactan, gelatin, Kappa carrageenan, copolymers of maleic anhydride with ethylene or methyl ether.

A tablet according to this aspect of this invention typically does not require a lubricant to improve the flow of the powder for tablet manufacturing. However, if it is so desired, preferred lubricants include talc, magnesium stearate, calcium stearate, stearic acid, hydrogenated vegetable oils, and carbowax in amount of between about 2 % to about homogeneous, the tablet may alternatively be comprised of regions of powdered Panax species 10 % by weight.

Similarly, a disintegrant does not appear necessary to produce rapid dissolve tablets using the present tablet composition. However, a disintegrant can be included to increase the speed with which a resulting tablet dissolves in the mouth. If desired, between about 0.5 % to about 1 % by weight of a disintegrant can be added. Preferred disintegrants include starches, clays, cellulose, algin, gums, crosslinked polymers (including croscarmellose, crospovidone, and sodium starch glycolate), VEEGUM®HV, agar, bentonite, natural sponge, cation exchange resins, aliginic acid, guar gum, citrus pulp, sodium lauryl sulphate in an amount of about 0.5 % to about 1 % of the total mass of the tablet.

It is also generally unnecessary to buffer the tablet composition. However, a buffer may be beneficial in specific formulations. Preferred buffering agents include mono- and di-sodium phosphates and borates, basic magnesium carbonate and combinations of magnesium and aluminum hydroxide.

In a preferred implementation, the tableting powder is made by mixing in a dry powdered form the various components as described above, e.g., active ingredient (Panax species extract composition), diluent, sweetening additive, and flavoring, etc. An overage in the range of about 10 % to about 15 % of the active extract of the active ingredient can be added to compensate for losses during subsequent tablet processing. The mixture is then sifted through a sieve with a mesh size preferably in the range of about 80 mesh to about 100 mesh to ensure a generally uniform composition of particles.

The tablet can be of any desired size, shape, weight, or consistency. The total weight of the Panax species extract composition in the form of a dry flowable powder in a single oral dosage is typically in the range of about 40 mg to about 600 mg. An important consideration is that the tablet is intended to dissolve in the mouth and should therefore not be of a shape that encourages the tablet to be swallowed. The larger the tablet, the less it is likely to be accidentally swallowed, but the longer it will take to dissolve or disintegrate. In a preferred form, the tablet is a disk or wafer of about 0.15 inch to about 0.5 inch in diameter and about 0.08 inch to about 0.2 inch in thickness, and has a weight of between about 160 mg to about 1,200 mg. In addition to disk, wafer or coin shapes, the tablet can be in the form of a cylinder, sphere, cube, or other shapes. Although the tablet is preferably extract composition separated by non-Panax species extract regions in periodic or non-periodic sequences, which can give the tablet a speckled appearance with different colors or shades of colors associated with the Panax species extract regions and the non-Panax species extract region.

Compositions of unique Panax species extract compositions may also comprise Panax species compositions in an amount between about 10 mg and about 750 mg per dose. The essential composition of the novel Panax species extract composition can vary wherein essential oil is in an amount between about 0.1 mg and about 10.0 mg. The total ginsenoside composition of the novel Panax species extract compositions can vary between about 1.0 mg and about 150 mg per dose wherein the % mass weight of the ginsenoside constituents in the unique Panax species extraction composition are greater in relation to the % mass weight of ginsenoside than that found in the natural Panax species plant material or

conventional Panax species extracts and beverages. The Panax species polysaccharide composition of the novel Panax species extract composition can vary between about 1.0 mg and about 400 mg wherein the % mass weight of the polysaccharide constituents are substantially increased in relation to the % mass weight of polysaccharides found in the natural Panax species plant material or conventional Panax species extracts or beverages. Finally, the % mass weight ratios of the three principal beneficial bioactive chemical constituents (essential oil, ginsenosides, and polysaccharides) derived from the Panax species may be altered to yield additional novel Panax species extract composition profiles for human oral delivery using the doses ranges mentioned previously.

An exemplary 275 mg tablet contains about 150.0 mg powdered predetermine unique Panax species extract composition, about 12.5 mg extract of Stevia, about 35.5 mg carboxymethylcellulose, and about 77.0 mg of lactose (see Example 1). Additional exemplary formations for 300 mg and 350 mg Panax species extraction composition tablets can be found in Examples 2 and 3.

The present invention comprises methods of using compositions comprising unique Panax species extraction compositions disclosed herein. Methods of providing dietary supplementation are contemplated. Such compositions may further comprise vitamins, minerals and antioxidants. Compositions taught herein can also be used in the methods of treatment of various physiological, psychological, and medical conditions. The standardized, reliable and novel Panax species extraction compositions of the present invention are used to prevent and treat cardiovascular and cerebrovascular disease and hypercholesterolemia. The compositions of the present invention can be used to provide cytoprotection and neural protection which are important to prevention of heart attacks and stroke. The novel Panax species extraction compositions are used to provide powerful antioxidant activity to human and animal cells and cell membranes and protect low density lipoprotein from oxidative damage. Pathologies that are related to oxygen radical damage include, but not limited to, cardiovascular disease, cerebrovascular disease (stroke), arthritis, inflammation, hepatic disorders, HIV, and cancer. The novel Panax species extraction compositions provide inhibition of platelet aggregation which is important to the prevention of heart attacks and stroke. Moreover, the Panax species extraction compositions of the present invention are used to provide immune enhancement which is important protection from infectious diseases, cancer and various pulmonary and hepatic diseases. Panax species extract compositions of the present invention have anti-

inflammatory activity and anti-diabetic activity. The novel Panax species extraction compositions are also used to prevent or treat neurodegenerative disease such as Alzheimer's and Parkinson's disease. Furthermore, the novel Panax species extraction compositions are used to enhance memory and cognition, relieve chronic fatigue syndromes, and enhance male erectile function. These and other related pathologies are prevented or treated by administering an effective amount of the novel Panax species extraction compositions of the present invention.

The novel Panax species extraction compositions may be administered daily, for one or more times, for the effective treatment of acute or chronic conditions. One method of the present invention comprises administering at least one time a day a composition comprising Panax species constituent compounds. Methods also comprise administering such compositions more than one time per day, more than two times per day, more than three times per day and in a range from 1 to 15 times per day. Such administration may be continuously, as in every day for a period of days, weeks, months, or years, or may occur at specific times to treat or prevent specific conditions. For example, a person may be administered Panax species extract compositions at least once a day for years to enhance mental focus, cognition, and relieve chronic fatigue, or to prevent cardiovascular disease or stroke.

All patents, patent applications and references included herein are specifically incorporated by reference in their entireties.

It should be understood, of course, that the foregoing relates only to exemplary embodiments of the present invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in this disclosure.

Although the exemplary embodiments of the present invention describe in detail methods and compositions for Panax extracts, there are numerous modifications or alterations that may suggest themselves to those skilled in the art for use of the methods and compositions herein for Panax extracts.

The present invention is further illustrated by way of the examples contained herein, which are provided for clarity of understanding. The exemplary embodiments should not be construed in any way as imposing limitations upon the scope thereof. On the contrary, it is to be clearly understood that resort may be had to various other embodiments,

modifications, and equivalents thereof which, after reading the description herein, may suggest themselves to those skilled in the art without departing from the spirit of the present invention and/or the scope of the appended claims.

EXEMPLIFICATION

EXAMPLE 1. Preparation of Essential Oil Fraction from *P. notoginseng*

30 gm of *P. notoginseng* rhizome feedstock was ground, passed through either a #8 or #20 mesh sieve, and then the resultant rhizome powders were collected. The ground feedstock was loaded into a 250 ml supercritical fluid extraction (SFE) vessel connected to an Applied Separations Supercritical Fluid Extraction Unit model Spe-ed SFE-2 (Allentown, Pa.). The non-adsorb cotton ball was packed at the top and bottom of the extraction vessel to avoid raw botanical flow together with the CO₂ stream. The oven was preheated to the desired temperature of 89 °C before the packed vessel was loaded. After the vessel was connected to the oven, the extraction system was tested for leakage by pressurizing the system with CO₂ (~ 60 bar), and purged. The system was closed and pressurized to the desired pressure of 400 bar using an air-driven liquid CO₂ pump. The system was then left for equilibrium for about 3 minutes. A sampling vial (40 ml) was weighed and connected to the sampling port at room temperature. The extraction was started by flowing CO₂ at a rate of 5.5-6.0 gm/min, which was controlled by a needle valve heated at 90 °C to avoid valve clogging by dry ice during depressurization. The solvent to feedstock ratio utilized was about 17-18/1 and the extraction time was 90 minutes. The total yield of the essential oil fraction from *P. notoginseng* was about 0.3% weight percent versus the weight of the initial feedstock, and the percent weight of the essential oil in this essential oil extract fraction was 100%. The feedstock residue was saved and used in additional extraction steps for extracting the ginsenoside and polysaccharide fractions (see Example 9). The results of this extraction process are shown in Example 18.

EXAMPLE 2. Preparation of Essential Oil Fraction from *P. quinquefolius*

30 gm of *P. quinquefolius* rhizome feedstock was ground, passed through either a #8 or #20 mesh sieve, and then the resultant rhizome powders were collected. The ground feedstock was loaded into a 250 ml supercritical fluid extraction (SFE) vessel connected to an Applied Separations Supercritical Fluid Extraction Unit model Spe-ed SFE-2 (Allentown, Pa.). The non-adsorb cotton ball was packed at the top and bottom of the extraction vessel to avoid raw botanical flow together with the CO₂ stream. The oven was

preheated to the desired temperature of 89 °C before the packed vessel was loaded. After the vessel was connected to the oven, the extraction system was tested for leakage by pressurizing the system with CO₂ (~ 60 bar), and purged. The system was closed and pressurized to the desired pressure of 400 bar using an air-driven liquid CO₂ pump. The system was then left for equilibrium for about 3 minutes. A sampling vial (40 ml) was weighed and connected to the sampling port at room temperature. The extraction was started by flowing CO₂ at a rate of 5.5-6.0 gm/min, which was controlled by a needle valve heated at 90 °C to avoid valve clogging by dry ice during depressurization. The solvent to feedstock ratio utilized was about 17-18/1 and the extraction time was 90 minutes. The total yield of the essential oil fraction from *P. quinquefolius* was about 0.2% weight percent versus the weight of the initial feedstock, and the percent weight of the essential oil in this essential oil extract fraction was 100%. The feedstock residue was saved and used in additional extraction steps for extracting the ginsenoside and polysaccharide fractions (see Figure 2 and Example 6). The results of this extraction process are shown in Example 19.

EXAMPLE 3. Preparation of Essential Oil Fraction from White Ginseng (*P. ginseng*)

30 gm of white ginseng (*P. ginseng*) rhizome feedstock was ground, passed through either a #8 or #20 mesh sieve, and then the resultant rhizome powders were collected. The ground feedstock was loaded into a 250 ml supercritical fluid extraction (SFE) vessel connected to an Applied Separations Supercritical Fluid Extraction Unit model Spe-ed SFE-2 (Allentown, Pa.). The non-adsorb cotton ball was packed at the top and bottom of the extraction vessel to avoid raw botanical flow together with the CO₂ stream. The oven was preheated to the desired temperature of 89 °C before the packed vessel was loaded. After the vessel was connected to the oven, the extraction system was tested for leakage by pressurizing the system with CO₂ (~ 60 bar), and purged. The system was closed and pressurized to the desired pressure of 400 bar using an air-driven liquid CO₂ pump. The system was then left for equilibrium for about 3 minutes. A sampling vial (40 ml) was weighed and connected to the sampling port at room temperature. The extraction was started by flowing CO₂ at a rate of 5.5-6.0 gm/min, which was controlled by a needle valve heated at 90 °C to avoid valve clogging by dry ice during depressurization. The solvent to feedstock ratio utilized was about 17-18/1 and the extraction time was 90 minutes. The total yield of the essential oil fraction from *P. quinquefolius* was about 0.5% weight percent versus the weight of the initial feedstock, and the percent weight of the essential oil in this essential oil extract fraction was 100%. The feedstock residue was saved and used in

additional extraction steps for extracting the ginsenoside and polysaccharide fractions (see Figure 2 and Example 7). The results of this extraction process are shown in Example 20.

EXAMPLE 4. Preparation of Essential Oil Fraction from Red Ginseng (*P. ginseng*)

30 gm of red ginseng (*P. ginseng*) rhizome feedstock was ground, passed through either a #8 or #20 mesh sieve, and then the resultant rhizome powders were collected. The ground feedstock was loaded into a 250 ml supercritical fluid extraction (SFE) vessel connected to an Applied Separations Supercritical Fluid Extraction Unit model Spe-ed SFE-2 (Allentown, Pa.). The non-adsorb cotton ball was packed at the top and bottom of the extraction vessel to avoid raw botanical flow together with the CO₂ stream. The oven was preheated to the desired temperature of 89 °C before the packed vessel was loaded. After the vessel was connected to the oven, the extraction system was tested for leakage by pressurizing the system with CO₂ (~ 60 bar), and purged. The system was closed and pressurized to the desired pressure of 400 bar using an air-driven liquid CO₂ pump. The system was then left for equilibrium for about 3 minutes. A sampling vial (40 ml) was weighed and connected to the sampling port at room temperature. The extraction was started by flowing CO₂ at a rate of 5.5-6.0 gm/min, which was controlled by a needle valve heated at 90 °C to avoid valve clogging by dry ice during depressurization. The solvent to feedstock ratio utilized was about 17-18/1 and the extraction time was 90 minutes. The total yield of the essential oil fraction from red ginseng was about 0.4% weight percent versus the weight of the initial feedstock, and the percent weight of the essential oil in this essential oil extract fraction was 100%. The feedstock residue was saved and used in additional extraction steps for extracting the ginsenoside and polysaccharide fractions (see Figure 2 and Example 8). The results of this extraction process are shown in Example 21.

EXAMPLE 5. Preparation of Ginsenoside Fraction from *P. notoginseng*

The residue of the 30 gm of ground rhizome (mesh # 20) after the essential oil was extracted (see Example 1, Step 1) from *P. notoginseng*, was extracted using a three stage solvent "leaching" process. In this method, the residue of the essential oil extraction (Step 1, Example 1, Figure 1) and 200 ml of extraction solvent (63% ethanol in water) was loaded into four flasks heated in a water bath (50-60° C) with stirring. The extraction was carried out for two hours. The resultant fluid extract was filtered using a Fisher P8 20 µm filter. The filtrate was collected as product and was measured for volume and solid content (dry mass as measured in grams). The extraction residue, material retained on the 20 micron

filter, was then used as a feedstock for the second stage of extraction using the same methods, and the process was repeated in the third stage. The residue was saved and used for the Step 4 extraction of the *P. notoginseng* polysaccharide fraction (Example 13, Figure 4). The results are tabulated in Tables 5 and 6,

Table 5. Three Stage Solvent Leaching Method for *P. notoginseng*

Stage	Extraction Solvent	Feedstock (gm)	Solvent (ml)	Extraction Time (hr)	Extracted Dry Wt (gm)	Yield (%)	Ginsenoside Content (%)
I	63% EtOH	30	200	2	6.3	21.01	57.75
II	63% EtOH	-	200	2	0.87	2.90	35.84
III	63% EtOH	-	200	2	0.22	0.73	20.59

Table 6. Distribution of Seven Major Ginsenosides in extracts of from *P. notoginseng*

Stage	Rg1 (%)	Re (%)	Rf (%)	Rb1 (%)	Rc (%)	Rb2 (%)	Rd\ (%)	Total*	GS Yield (%)**
Root	7.00	1.14	0.06	2.73	0.03	0.09	0.74	12.26	
I	31.13	5.08	0.34	12.22	0.18	0.47	3.33	52.75	90.31
II	21.90	3.48	0.00	8.34	0.00	0.00	2.11	35.84	98.77
III	12.83	2.15	0.00	4.48	0.00	0.00	1.14	20.59	100.00

*The total ginsenosides was calculated based on the seven ginsenoside calibrated. There are some other ginsenoside detected (< 5%) but not calibrated due to lack of reference standard. Thus, the total ginsenoside content is somewhat higher than the number cited in the table.

**The total ginsenoside yield in the extracts that were accumulated by adding each extraction stage.

EXAMPLE 6. Preparation of Ginsenoside Fraction from *P. quinquefolius*

A typical experimental example of Step 2 solvent extraction of the ginsenoside fraction is as follows: the residue of the 30 gm of ground rhizome (mesh # 20) after the essential oil was extracted (see Example 1, Step 1) from *P. quinquefolius*, was extracted using a three stage solvent “leaching” process. In this method, the residue of the essential oil extraction (Step 1, Example 2, Figure 1) and 200 ml of extraction solvent (63% ethanol in water) was loaded into four flasks heated in a water bath (50-60° C) with stirring. The extraction was carried out for two hours. The resultant fluid extract was filtered using a

Fisher P8 20 μ m filter. The filtrate was collected as product and was measured for volume and solid content (dry mass as measured in grams). The extraction residue, material retained on the 20 micron filter, was then used as a feedstock for the second stage of extraction using the same methods, and the process was repeated in the third stage. The residue was saved and used for the Step 4 extraction of the *P. quinquefolius* polysaccharide fraction (Example 14, Figure 4). The results are tabulated in Tables 7 and 8,

Table 7. Three Stage Solvent Leaching Method for *P. quinquefolius*

Stage	Extraction Solvent	Feedstock (gm)	Solvent (ml)	Extraction Time (hr)	Extracted Dry Wt (gm)	Yield (%)	Ginsenoside Content (%)
I	63% EtOH	30	200	2	2.35	7.83	22.10
II	63% EtOH	-	200	2	2.04	6.80	7.34
III	63% EtOH	-	200	2	0.54	0.80	5.07

Table 8. Distribution of Seven Major Ginsenoside in extracts from *P. quinquefolius*

Stage	Rg1 (%)	Re (%)	Rf (%)	Rb1 (%)	Rc (%)	Rb2 (%)	Rd\ (%)	Total*	GS Yield (%)**
Root	0.34	0.45	0.00	1.12	0.13	0.06	0.20	2.32	
I	2.89	4.36	0.00	10.64	1.33	0.77	1.89	22.10	74.55
II	1.41	1.30	0.00	3.56	0.43	0.00	0.64	7.34	96.00
III	1.22	0.89	0.00	2.44	0.00	0.00	0.48	5.07	100.00

*, **see Table 5.

EXAMPLE 7. Preparation of Ginsenoside Fraction from White Ginseng (*P. Ginseng*)

A typical experimental example of Step 2 solvent extraction of the ginsenoside fraction is as follows: the residue of the 30 gm of ground rhizome (mesh # 20) after the essential oil was extracted (see Example 1, Step 1) from white ginseng (*P. ginseng*), was extracted using a three stage solvent "leaching" process. In this method, the residue of the essential oil extraction (Step 1, Example 3, Figure 1) and 200 ml of extraction solvent (63% ethanol in water) was loaded into four flasks heated in a water bath (50-60° C) with stirring. The extraction was carried out for two hours. The resultant fluid extract was filtered using a Fisher P8 20 μ m filter. The filtrate was collected as product and was measured for volume and solid content (dry mass as measured in grams). The extraction residue, material retained on the 20 micron filter, was then used as a feedstock for the second stage of extraction using the same methods, and the process was repeated in the third stage. The

residue was saved and used for the Step 4 extraction of the white ginseng polysaccharide fraction (Example 15, Figure 4). The results are tabulated in Tables 9 and 10.

Table 9. Three Stage Solvent Leaching Method for White Ginseng (*P. ginseng*)

Stage	Extraction Solvent	Feedstock (gm)	Solvent (ml)	Extraction Time (hr)	Extracted Dry Wt (gm)	Yield (%)	Ginsenoside Content (%)
I	63% EtOH	30	200	2	7.94	26.45	9.81
II	63% EtOH	-	200	2	2.48	8.25	6.06
III	63% EtOH	-	200	2	0.81	2.70	3.38

Table 10. Distribution of Seven Major Ginsenoside in extracts from White Ginseng (*P. ginseng*)

Stage	Rg1 (%)	Re (%)	Rf (%)	Rb1 (%)	Rc (%)	Rb2 (%)	Rd\ (%)	Total*	GS Yield (%)**
Root	0.81	0.31	0.11	0.83	0.52	0.48	0.17	3.19	
I	2.45	0.89	0.34	2.51	1.63	1.48	0.51	9.81	81.46
II	1.54	0.74	0.19	1.72	1.08	0.89	0.37	6.06	97.13
III	1.24	0.49	0.00	0.96	0.00	0.42	0.00	3.38	100.00

*,**see Table 5.

EXAMPLE 8. Preparation of Ginsenoside Fraction from Red Ginseng (*P. Ginseng*)

A typical experimental example of Step 2 solvent extraction of the ginsenoside fraction is as follows: the residue of the 30 gm of ground rhizome (mesh # 20) after the essential oil was extracted (see Example 1, Step 1) from red ginseng (*P. ginseng*), was extracted using a three stage solvent "leaching" process. In this method, the residue of the essential oil extraction (Step 1, Example 4, Figure 1) and 200 ml of extraction solvent (63% ethanol in water) was loaded into four flasks heated in a water bath (50-60° C) with stirring. The extraction was carried out for two hours. The resultant fluid extract was filtered using a Fisher P8 20 µm filter. The filtrate was collected as product and was measured for volume and solid content (dry mass as measured in grams). The extraction residue, material retained on the 20 micron filter, was then used as a feedstock for the second stage of extraction using the same methods, and the process was repeated in the third stage. The residue was saved and used for the Step 4 extraction of the red ginseng polysaccharide fraction (Example 16, Figure 4). The results are tabulated in Tables 11 and 12.

Table 11. Three Stage Solvent Leaching Method for Red Ginseng (*P. ginseng*)

Stage	Extraction Solvent	Feedstock (gm)	Solvent (ml)	Extraction Time (hr)	Extracted Dry Wt (gm)	Yield (%)	Ginsenoside Content (%)
I	63% EtOH	30	200	2	8.34	28.10	4.65
II	63% EtOH	-	200	2	3.40	11.34	4.54
III	63% EtOH	-	200	2	1.17	3.91	0.48

Table 12. Distribution of Seven Major Ginsenoside in extracts from Red Ginseng

Stage	Rg1 (%)	Re (%)	Rf (%)	Rb1 (%)	Rc (%)	Rb2 (%)	Rd\ (%)	Total*	GS Yield (%)**
Root	0.56	0.19	0.07	0.40	0.26	0.25	0.10	1.84	
I	1.42	0.50	0.16	1.04	0.59	0.72	0.27	4.65	71.00
II	1.33	0.43	0.19	0.97	0.86	0.47	0.29	4.54	98.98
III	0.39	0.10	0.00	0.00	0.00	0.00	0.00	0.49	100.00

*, **see Table 5

EXAMPLE 9. Polymer Adsorbent Purification of Ginsenoside Fraction from *P. notoginseng*

In a typical experiment (Step 3, Figure 3), the two stage solvent leaching ginsenoside extract fraction obtained from the *P. notoginseng* original 30 gm feedstock was first evaporated under reduced atmospheric pressure to remove the ethanol and then diluted with water to the original volume to keep the triterpene saponin concentration unchanged. 40 gm of the polymer adsorbent resin ADS-8 (Nankai University, Tianjin, China) was washed with water and ethanol before and after being loaded into a column (50 cm L x 1 cm ID, ~40 cm³). The ginsenoside aqueous extract fraction was loaded onto the column at a flow rate of 80 to 100 ml/hr. The optimal flow rate through the resin bed was in the range of 2 to 4 bed volume/hr. The volume and concentration of the solution that passed through the polymer adsorbent resin bed was measured and recorded so as to determine the breakthrough curve. Once the column was fully loaded, the column was washed with 400 ml of water at a flow rate of 50 ml/hour to remove the impurities from the adsorbed ginsenosides. Elution of the ginsenosides was then accomplished with 150 ml of ethanol/water (4/1) as an eluting solvent at a flow rate of 50 ml/hr and the elution curve was recorded. For the extract, the loading capacity of the adsorbent resin ADS-8 was about 50 to 75 mg

ginsenoside per gram of adsorbent resin. Results from this experiments are tabulated in Tables 13 and 14.

Table 13. Ginsenoside Yield following column chromatography using ADS-8 resin.

Stage	Amount (g or ml)	Dry Wt (g)	Yield (% Wt)	Ginsenoside Content (%)	Ginsenoside Yield (%)
P. notoginseng root	30 g	-	-	12.27	
EtOH/Water Extract	375 ml	7.1	23.7	50.70	98.0
PA Column Extract	25 ml	2.4	8.0	94.91	64.2

Table 14. Comparison of Ginsenoside Distribution in the Elution at Peak with the Ginseng Root Feedstock and the Solvent Leaching Extract (% dry weight)

Ginsenoside Source	Rg1	Re	Rf	Rb1	Rc	Rb2	Rd	Total
P notoginseng root	7.00	1.14	0.06	2.73	0.03	0.09	0.74	12.27
EtOH/Water Extract	30.01	4.88	0.30	11.75	0.16	0.41	3.18	50.70
Elution @ 30 ml	38.74	6.50	2.88	30.97	1.52	0.75	13.55	94.91

EXAMPLE 10. Polymer Adsorbent Purification of Ginsenoside Fraction from *P. quinquefolius*

In a typical experiment (Step 3, Figure3), the two stage solvent leaching ginsenoside extract fraction obtained from the *P. quinquefolius* original 30 gm feedstock was first evaporated under reduced atmospheric pressure to remove the ethanol and then diluted with water to the original volume to keep the triterpene saponin concentration unchanged. 40 gm of the polymer adsorbent resin ADS-8 (Nankai University, Tianjin, China) was washed with water and ethanol before and after being loaded into a column (50 cm L x 1 cm ID, ~40 cm³). The ginsenoside aqueous extract fraction was loaded onto the column at a flow rate of 80 to 100 ml/hr. The optimal flow rate through the resin bed was in the range of 2 to 4 bed volume/hr. The volume and concentration of the solution that passed through the polymer adsorbent resin bed was measured and recorded so as to determine the break-through curve. Once the column was fully loaded, the column was washed with 400 ml of water at a flow rate of 50 ml/hour to remove the impurities from the adsorbed ginsenosides. Elution of the ginsenosides was then accomplished with 150 ml of ethanol/water (4/1) as an eluting solvent at a flow rate of 50 ml/hr and the elution curve was recorded. For the extract, the loading capacity of the adsorbent resin ADS-8 was about 50 to 75 mg ginsenoside per gram of adsorbent resin. Results from this experiments are tabulated in

Tables 15 and 16.

Table 15. Ginsenoside Yield following column chromatography using ADS-8 resin.

Stage	Amount (g or ml)	Dry Wt (g)	Yield (% Wt)	Ginsenoside Content (%)	Ginsenoside Yield (%)
P. quinquefolius root	30			2.32	
EtOH/Water Extract	375	4.7	14.3	15.2	96.0
PA Column Extract	11	0.11	0.33	98.7	14.1

Table 16. Comparison of Ginsenoside Distribution in the Elution at Peak with the Ginseng Root Feedstock and the Solvent Leaching Extract (% dry weight).

Ginsenoside Source	Rg1	Re	Rf	Rb1	Rc	Rb2	Rd	Total
P. quinquefolius root	0.34	0.45	0.00	1.12	0.13	0.06	0.20	2.32
EtOH/Water Extract	2.20	2.94	0.00	7.35	0.91	0.41	1.31	15.24
Elution @ 30 ml	25.48	1.11	1.08	60.12	1.55	2.16	6.49	98.00

EXAMPLE 11. Polymer Adsorbent Purification of Ginsenoside Fraction from White Ginseng (*P. ginseng*)

In a typical experiment (Step 3, Figure 3), the two stage solvent leaching ginsenoside extract fraction obtained from the white ginseng (*P. ginseng*) original 22 gm feedstock was first evaporated under reduced atmospheric pressure to remove the ethanol and then diluted with water to the original volume to keep the triterpene saponin concentration unchanged. 40 gm of the polymer adsorbent resin ADS-8 (Nankai University, Tianjin, China) was washed with water and ethanol before and after being loaded into a column (50 cm L x 1 cm ID, ~40 cm³). The ginsenoside aqueous extract fraction was loaded onto the column at a flow rate of 80 to 100 ml/hr. The optimal flow rate through the resin bed was in the range of 2 to 4 bed volume/hr. The volume and concentration of the solution that passed through the polymer adsorbent resin bed was measured and recorded so as to determine the break-through curve. Once the column was fully loaded, the column was washed with 400 ml of water at a flow rate of 50 ml/hour to remove the impurities from the adsorbed ginsenosides. Elution of the ginsenosides was then accomplished with 150 ml of ethanol/water (4/1) as an eluting solvent at a flow rate of 50 ml/hr and the elution curve was recorded. For the extract, the loading capacity of the adsorbent resin ADS-8 was about 50 to 75 mg ginsenoside per gram of adsorbent resin. Results from this experiments are tabulated in Tables 17 and 18.

Table 17. Ginsenoside Yield following column chromatography using ADS-8 resin.

Stage	Amount (g or ml)	Dry Wt (g)	Yield (% Wt)	Ginsenoside Content (%)	Ginsenoside Yield (%)
White Ginseng root	22 g			3.19	
EtOH/Water Extract	250	8.65	39.4	4.62	99.1
PA Column Extract	20 ml	0.16	0.73	99.3	22.7

Table 18. Comparison of Ginsenoside Distribution in the Elution at Peak with the Ginseng Root Feedstock and the Solvent Leaching Extract (% dry weight)

Ginsenoside Source	Rg1	Re	Rf	Rb1	Rc	Rb2	Rd	Total
White ginseng root	0.81	0.31	0.11	0.83	0.52	0.48	0.17	3.19
EtOH/Water Extract	2.24	0.86	0.30	2.32	1.50	1.34	0.48	8.92
Elution @ 30 ml	31.84	7.94	5.71	22.75	15.41	10.64	3.73	99.30

EXAMPLE 12. Polymer Adsorbent Purification of Ginsenoside Fraction from Red Ginseng (*P. Ginseng*)

In a typical experiment (Step 3, Figure 3), the two stage solvent leaching ginsenoside extract fraction obtained from the red ginseng (*P. ginseng*) original 22 gm feedstock was first evaporated under reduced atmospheric pressure to remove the ethanol and then diluted with water to the original volume to keep the triterpene saponin concentration unchanged. 40 gm of the polymer adsorbent resin ADS-8 (Nankai University, Tianjin, China) was washed with water and ethanol before and after being loaded into a column (50 cm L x 1 cm ID, ~40 cm³). The ginsenoside aqueous extract fraction was loaded onto the column at a flow rate of 80 to 100 ml/hr. The optimal flow rate through the resin bed was in the range of 2 to 4 bed volume/hr. The volume and concentration of the solution that passed through the polymer adsorbent resin bed was measured and recorded so as to determine the break-through curve. Once the column was fully loaded, the column was washed with 400 ml of water at a flow rate of 50 ml/hour to remove the impurities from the adsorbed ginsenosides. Elution of the ginsenosides was then accomplished with 150 ml of ethanol/water (4/1) as an eluting solvent at a flow rate of 50 ml/hr and the elution curve was recorded. For the extract, the loading capacity of the adsorbent resin ADS-8 was about 50 to 75 mg ginsenoside per gram of adsorbent resin. Results from this experiments are tabulated in Tables 19 and 20.

Table 19. Ginsenoside Yield following column chromatography using ADS-8 resin.

Stage	Amount (g or ml)	Dry Wt (g)	Yield (% Wt)	Ginsenoside Content (%)	Ginsenoside Yield (%)
Red Ginseng Root	22 g			1.84	
EtOH/Water Extract	250	8.65	39.4	4.62	99.1
PA Column Extract	10	0.19	0.85	96.8	44.7

Table 20. Comparison of Ginsenoside Distribution in the Elution at Peak with the Ginseng Root Feedstock and the Solvent Leaching Extract (% dry weight).

Ginsenoside Source	Rg1	Re	Rf	Rb1	Rc	Rb2	Rd	Total
Red Ginseng Root	0.56	0.19	0.07	0.40	0.26	0.25	0.10	1.84
EtOH/Water Extract	1.39	0.48	0.17	1.02	0.67	0.64	0.24	4.62
Elution @ 30 ml	35.23	9.01	5.19	19.73	13.64	10.46	3.66	96.8

EXAMPLE 13. Preparation of Polysaccharide Fraction from *P. notoginseng*

In a typical experimental protocol, the residue from defatted (essential oil fraction removed, Step 1, Figure 1, Example 1), de-saponinized (ginsenoside fraction removed, Step 2, Figure 2, Example 5) 30 gm ginseng root feedstock powder derived from *P. notoginseng* was loaded into a 500 ml flask. This residue was extracted three times with boiling water for two hours. The volume of water used in each instance was 500 ml, 500 ml, and then 300 ml. The solutions were freeze dried to determine the solid concentration (Table 21). The extraction yield was 47.22% indicating that almost 100% of the polysaccharides were extracted from the *P. notoginseng* feedstock. Moreover, the polysaccharide extract fractions were highly purified, probably greater 99% mixtures of polysaccharides of various molecular weights (see Example 30 for analysis).

Table 21. Polysaccharide yield from *P. notoginseng*

Stage	Extraction Solvent	Solvent Vol (ml)	Feed (g)	Extraction Time	Yield (% Dry Wt)	Polysaccharide (% Yield)
I	Water	500	30	2	29.80	63.1
II	Water	500	-	2	10.58	22.4
III	Water	500	-	2	6.84	14.5

EXAMPLE 14. Preparation of Polysaccharide Fraction from *P. quinquefolius*

In a typical experimental protocol, the residue from defatted (essential oil fraction

removed, Step 1, Figure 1, Example 2), de-sapponinized (ginsenoside fraction removed, Step 2, Figure 2, Example 6) 30 gm ginseng root feedstock powder derived from *P. quinquefolius* was loaded into a 500 ml flask. This residue was extracted three times with boiling water for two hours. The volume of water used in each instance was 500 ml, 500 ml, and then 300 ml. The solutions were freeze dried to determine the solid concentration (Table 22). The extraction yield was 18.78% indicating that almost 100% of the polysaccharides were extracted from the *P. quinquefolius* feedstock. Moreover, the polysaccharide extract fractions were highly purified, probably greater 99% mixtures of polysaccharides of various molecular weights (see Example 30 for analysis).

Table 22. Polysaccharide yield from *P. quinquefolius*.

Stage	Extraction Solvent	Solvent Vol (ml)	Feed (g)	Extraction Time	Yield (% Dry Wt)	Polysaccharide (% Yield)
I	Water	500	30	2	13.88	73.9
II	Water	500	-	2	3.73	19.9
III	Water	500	-	2	1.16	6.2

EXAMPLE 15. Preparation of Polysaccharide Fraction from White Ginseng (*P. ginseng*)

In a typical experimental protocol, the residue from defatted (essential oil fraction removed, Step 1, Figure 1, Example 3), de-sapponinized (ginsenoside fraction removed, Step 2, Figure 2, Example 7) 30 gm ginseng root feedstock powder derived from white ginseng (*P. ginseng*) was loaded into a 500 ml flask. This residue was extracted three times with boiling water for two hours. The volume of water used in each instance was 500 ml, 500 ml, and then 300 ml. The solutions were freeze dried to determine the solid concentration (Table 21). The extraction yield was 17.44% indicating that almost 100% of the polysaccharides were extracted from the white ginseng feedstock. Moreover, the polysaccharide extract fractions were highly purified, probably greater 99% mixtures of polysaccharides of various molecular weights (see Example 30 for analysis).

Table 23. Polysaccharide yield from white ginseng (*P. ginseng*)

Stage	Extraction Solvent	Solvent Vol (ml)	Feed (g)	Extraction Time	Yield (% Dry Wt)	Polysaccharide (% Yield)
I	Water	500	30	2	11.43	65.6
II	Water	500	-	2	4.01	22.9
III	Water	500	-	2	2.10	11.5

EXAMPLE 16. Preparation of Polysaccharide Fraction from Red Ginseng (*P. ginseng*)

In a typical experimental protocol, the residue from defatted (essential oil fraction removed, Step 1, Figure 1, Example 4), de-sapponinized (ginsenoside fraction removed, Step 2, Figure 2, Example 8) 30 gm ginseng root feedstock powder derived from red ginseng (*P. ginseng*) was loaded into a 500 ml flask. This residue was extracted three times with boiling water for two hours. The volume of water used in each instance was 500 ml, 500 ml, and then 300 ml. The solutions were freeze dried to determine the solid concentration (Table 24). The extraction yield was 47.22% indicating that almost 100% of the polysaccharides were extracted from the red ginseng feedstock. Moreover, the polysaccharide extract fractions were highly purified, probably greater 99% mixtures of polysaccharides of various molecular weights (see Example 30 for analysis).

Table 24. Polysaccharide yield from red ginseng (*P. ginseng*).

Stage	Extraction Solvent	Solvent Vol (ml)	Feed (g)	Extraction Time	Yield (% Dry Wt)	Polysaccharide (% Yield)
I	Water	500	30	2	21.30	81.5
II	Water	500	-	2	3.85	14.7
III	Water	500	-	2	0.98	3.7

EXAMPLE 17. HPLC Methods

HPLC analysis of ginseng extracts and fractions was carried out using a Shimadzu SE0405003 HPLC system equipped with the following Shimadzu equipment: a SCL-10A $\dot{V}$ P System Controller, a DGU-14A four-line vacuum membrane degasser, a FCV-10AL $\dot{V}$ P low pressure gradient unit, a LC-10AT $\dot{V}$ P serial plunger solvent delivery unit, a 100 microliter semi-micro mixer, a SIL-10AF fast autosampler, a SPD-M10A $\dot{V}$ P UV-Vis photodiode array detector, a CTO-10ASvp column oven, Class VP 7.2.1 SP1 chromatography software, and a FRC-10A fraction collector. The column used in Examples 18-25 was a Jupiter 5 μ C18 300A, 250 x 4.6 mm column obtained from Phenomenex, Inc. Solvents used in HPLC methods, including water, ethanol, methanol, and acetonitrile, were HPLC grade and were obtained from Sigma-Aldrich, Inc.

EXAMPLE 18. HPLC Characterization of an Essential Oil Fraction from *P. notoginseng*

An essential oil fraction from *P. notoginseng* was prepared as described in Example 1. HPLC analysis was carried using the methods and equipment described in Example 17 with the specific conditions described herein. The essential oil fraction sample was

dissolved in HPLC-grade methanol at a concentration of 3 mg/ml. The sample injection volume was 10 μ l. The mobile phase components were as follows: mobile phase component A was phosphate buffer, 0.5% phosphoric acid in water, pH 3.5 ("A"); mobile phase component B was methanol ("B"); and mobile phase component C was acetonitrile ("C"). The concentration gradient elution program used was as follows: the initial mobile phase composition comprised on a volume basis 50%, 17%, and 33%, respectively, of A, B, and C; and, at 40 min following sample injection the mobile phase composition comprised on a volume basis 25%, 25%, and 50%, respectively, of A, B, and C. The mobile phase was linear gradient in 490 minutes changing from initially 50:17:33 to 25:25:50 A:B:C and then hold at this condition for another 10 minutes. The total analysis time was 50 min, the mobile phase flow rate was 1 ml per min and the column temperature was controlled at 45°C. Peak detection was at 254 nm. The data from the HPLC chromatogram are given Tables 25 and 26.

Table 25. HPLC peak retention times for *P. notoginseng* essential oil fraction.

Peak No.	Ret Time (Min)	Peak No.	Ret Time (Min)	Peak No	Ret Time (Min)
1010	5.163	1029	18.112	1049	35.701
1011	5.760	1030	18.507	1050	35.938
1012	6.432	1031	18.061	1051	37.760
1013	7.424	1032	19.296	1052	38.923
1014	8.107	1033	19.669	1053	39.285
1015	8.832	1034	21.195	1054	40.107
1016	9.141	1035	21.781	1055	40.469
1017	9.643	1036	22.325	1056	41.088
1018	10.635	1037	22.923	1057	42.165
1019	11.221	1038	23.797	1058	43.040
1020	12.000	1039	24.480	1059	43.488
1021	12.651	1040	26.165	1060	44.629
1022	13.888	1041	27.808	1061	45.163
1023	13.995	1042	28.213	1062	47.659
1024	14.624	1043	28.757	1063	49.461
1025	15.467	1044	29.237		
1026	16.064	1045	30.496		
1027	16.800	1046	31.328		
1028	17.547	1047	33.408		
1026	16.064	1048	34.848		

Table 26. HPLC analytical data from *P. notogenseng* essential oil fraction.

Peak Reference No.	Retention time (Min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
1010	5.163	729554	28473	0.52	1577
1011	5.760	819443	36624	0.52	1963
1012	6.432	1452476	51498	0.95	733
1013	7.424	802293	24030	0.77	1487
1014	8.107	950323	46764	0.75	1869
1015	8.832	165736	11151	0.27	17120
1016	9.141	459358	24121	0.44	6906
1017	9.643	1464010	48140	1.11	1208
1018	10.635	279640	9882	0.51	6958
1019	11.221	762472	23871	0.91	2433
1020	12.000	139655	7655	0.32	22500
1021	12.651	130405	49437	1.16	1903
1025	15.467	179407	7022	0.47	17328
1027	16.800	2232358	80899	1.10	3732
1030	18.507	106150	6788	0.27	75173
1032	19.296	136114	10101	0.23	112616
1033	19.669	1503880	53757	1.41	3113
1034	21.195	334247	10696	0.79	11517
1035	21.781	187856	8163	0.46	35872
1037	22.923	1315180	49311	0.80	13137
1038	23.797	946391	31041	0.77	15282
1039	24.480	1218557	34747	1.62	3654
1040	26.165	698311	21270	1.57	4444
1043	28.757	119531	4332	0.58	39332
1046	31.328	277161	6243	1.14	12083
1048	34.848	100553	2633	0.71	38544
1050	35.936	234739	5643	0.99	21082
1051	37.760	128902	3483	0.68	49336
1054	40.107	116560	6216	0.39	169212
1056	41.088	401550	12183	1.02	25963
1059	43.488	438790	13497	0.97	32160
1060	44.629	1026165	48501	0.63	80292
1061	45.163	2300562	75294	2.12	7261

EXAMPLE 19. HPLC Characterization of an Essential Oil Fraction from *P. quinquefolius*

An essential oil fraction from *P. quinquefolius* was prepared as described in Example 2. HPLC analysis was carried out as described in Example 18. The retention times for the designated peaks from the HPLC chromatogram are given Table 27. Additional data for representative peaks from the HPLC chromatogram are given in Table

28.

Table 27. HPLC retention times for *P. quinquefolius* essential oil fraction

Peak No.	Ret Time (Min)	Peak No.	Ret Time (Min)	Peak No.	Ret Time (Min)
2010	5.483	2031	16.939	2052	31.477
2011	5.877	2032	17.269	2053	32.096
2012	6.123	2033	17.537	2054	33.675
2013	6.368	2034	18.069	2055	34.507
2014	7.029	2035	18.613	2056	34.773
2015	7.691	2036	19.925	2057	36.075
2016	8.608	2037	21.045	2058	36.672
2017	9.099	2038	21.536	2059	37.739
2018	9.792	2039	22.357	2060	38.155
2019	10.069	2040	22.709	2061	38.901
2010	5.483	2041	23.179	2062	39.328
2021	11.339	2042	24.363	2063	40.000
2022	11.925	2043	24.832	2064	40.971
2023	12.853	2044	26.112	2065	41.472
2024	13.195	2045	26.869	2066	41.835
2025	13.867	2046	27.424	2067	42.304
2026	14.624	2047	28.053	2068	43.509
2027	14.860	2048	29.301	2069	46.325
2028	15.243	2049	30.138	2070	46.859
2029	15.669	2050	30.319	2072	48.021
2030	16.288	2051	31.051		

Table 28. HPLC data for *P. quinquefolius* essential oil fraction.

Peak Reference No.	Retention time (Min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
2011	5.877	150013	14034	0.18	17056
2013	6.368	430822	26350	0.43	3509
2017	9.099	1146303	60042	0.85	1833
2018	9.792	67025	5204	0.22	31697
2020	10.571	400240	13788	0.84	2534
2021	11.339	112153	5432	0.43	11126
2022	11.925	763520	33956	1.08	1951
2023	12.853	93320	5697	0.35	21577
2029	15.669	1290672	53585	0.80	6138
2031	16.639	105596	5362	0.36	34180
2035	18.613	1203276	50697	1.25	3548
2036	19.925	167289	5588	0.85	8792
2037	21.045	510534	16352	0.91	8557
2039	22.357	217905	13254	0.34	69181
2040	22.709	373474	19172	0.43	44625

2042	24.363	41101	2107	0.35	77526
2044	26.112	6263	225	0.74	19922
2048	29.301	48734	1562	1.02	13203
2053	32.096	41998	1449	1.32	9460
2055	34.507	86605	4169	0.69	40016
2057	36.075	16710	891	0.34	180125
2059	37.739	45847	1617	0.61	61241
2063	40.000	62679	1711	0.86	34613
2064	40.971	74440	3156	0.55	88787
2068	43.509	1207959	29593	2.83	3782
2069	46.325	28406	716	0.77	57912

EXAMPLE 20. HPLC Characterization of an Essential Oil Fraction from White Ginseng (*P. ginseng*)

An essential oil fraction from White Ginseng (*P. ginseng*) was prepared as described in Example 3. HPLC analysis was carried out as described in Example 18. The retention times for the designated peaks from the HPLC chromatogram are given Table 29. Additional data for representative peaks from the HPLC chromatogram are given in Table 30.

Table 29. HPLC peak retention times for white ginseng essential oil fraction.

Peak No.	Ret Time (Min)	Peak No.	Ret Time (Min)	Peak No	Ret Time (Min)
3010	5.163	3031	18.133	3052	34.133
3011	5.621	3032	18.667	3053	34.464
3012	5.920	3033	18.869	3054	35.339
3013	6.261	3034	19.253	3055	36.907
3014	6.485	3035	20.267	3056	37.525
3015	7.051	3036	20.971	3057	38.005
3016	7.200	3037	21.739	3058	38.848
3017	7.659	3038	22.059	3059	40.213
3018	8.085	3039	22.699	3060	40.821
3019	8.853	3040	24.395	3061	41.589
3020	9.333	3041	25.707	3062	41.771
3021	10.069	3042	26.208	3063	42.400
3022	10.315	3043	26.624	3064	42.997
3023	10.912	3044	27.168	3065	45.568
3024	11.925	3045	28.341	3066	46.165
3025	12.245	3046	28.821		
3026	13.749	3047	29.813		
3027	14.635	3048	30.549		
3028	15.563	3049	30.933		
3029	16.352	3050	31.669		

3030	17.141	3051	33.045		
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Table 30. HPLC data for white ginseng essential oil fraction.

Peak Reference No.	Retention time (Min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
3010	5.163	435461	20638	0.54	1463
3011	5.621	218148	12460	0.36	3901
3014	6.485	256854	12888	0.48	2921
3018	8.085	208736	8568	0.66	2401
3019	8.853	120925	6129	0.45	6193
3020	9.333	171698	4912	0.82	2073
3022	10.315	48577	2528	0.35	13897
3023	10.912	213142	6700	1.11	1546
3024	11.925	56033	2638	0.38	15757
3028	15.563	353363	8748	0.96	4205
3030	17.141	65996	2690	0.54	16121
3032	18.667	51034	3348	0.31	58016
3034	19.325	1047860	46490	0.99	6097
3036	20.971	647313	14806	1.01	6898
3038	22.059	352675	15815	0.53	27717
3039	22.699	480051	16849	1.32	4731
3040	24.395	453299	17408	1.91	2610
3042	26.208	724	66	0.23	207746
3046	28.821	14552	483	0.89	16779
3050	31.669	16676	602	0.87	21201
3053	34.464	7799	496	0.29	225972
3055	36.907	15720	818	0.33	200129
3056	37.525	52162	1341	0.77	38000
3059	40.213	125450	4619	0.69	54344
3060	40.821	224164	6508	0.84	37786
3064	42.997	754815	9586	2.11	6644
3066	46.165	250921	3010	1.58	13659

EXAMPLE 21. HPLC Characterization of an Essential Oil Fraction from Red Ginseng (*P. ginseng*).

An essential oil fraction from Red Ginseng (*P. ginseng*) was prepared as described in Example 4. HPLC analysis was carried out as described in Example 18. The retention times for the designated peaks from the HPLC chromatogram are given Table 31. Additional data for representative peaks from the HPLC chromatogram are given in Table 32.

Table 31. HPLC peak retention times for white ginseng essential oil fraction.

Peak No.	Ret Time (Min)	Peak No.	Ret Time (Min)	Peak No	Ret Time (Min)
4010	5.152	4031	16.011	4052	41.376
4011	5.611	4032	16.395	4053	42.784
4012	6.272	4033	18.208	4054	43.275
4013	6.539	4034	18.656	4055	43.989
4014	7.072	4035	19.307	4056	46.251
4015	7.224	4036	20.768	4057	47.488
4016	7.936	4037	21.419	4058	47.968
4017	8.277	4038	22.101	4059	48.619
4018	8.875	4039	23.520	4060	48.875
4019	9.280	4040	24.352	4061	49.483
4020	10.091	4041	25.888		
4021	10.421	4042	27.339		
4022	10.645	4043	28.875		
4023	10.923	4044	30.603		
4024	12.021	4045	30.660		
4025	12.309	4046	31.680		
4026	12.853	4047	32.981		
4027	13.931	4048	34.155		
4028	14.453	4049	35.360		
4029	15.147	4050	37.963		
4030	15.456	4051	38.773		

Table 32. HPLC data for red ginseng essential oil fraction.

Peak Reference No.	Retention time (Min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
4010	5.152	270699	11709	0.53	1512
4013	6.539	242062	9947	0.57	2106
4017	8.277	38650	2745	0.26	16215
4018	8.875	73098	3339	0.45	6223
4019	9.280	168194	6791	0.81	2100
4021	10.421	46687	2493	0.33	15956
4022	10.645	18831	2287	0.14	92503
4024	12.021	16362	1461	0.19	64046
4026	12.853	22373	1248	0.31	27505
4030	15.456	41472	2329	0.35	31202
4032	16.395	203394	6641	1.38	2258
4034	18.656	54002	1903	0.54	19097
4035	19.307	1199447	53586	1.47	2760
4037	21.419	142247	5661	0.63	18494
4038	22.101	696614	25600	1.42	3876
4039	23.520	14330	574	0.52	32733
4040	24.352	125606	3186	1.96	2470
4041	25.888	2339	102	0.57	33004

Peak Reference No.	Retention time (Min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
4043	28.875	1692	109	0.53	47491
4046	31.680	9819	293	0.94	18173
4048	34.155	8113	253	0.99	19044
4050	37.963	15537	282	1.32	13234
4051	38.773	35999	959	1.65	8835
4052	41.376	79054	1607	2.59	4083
4054	43.275	49934	1479	0.69	62936
4055	43.989	75015	1926	1.76	9995
4056	46.251	5586	143	1.16	25436

EXAMPLE 22. HPLC Characterization of Ginsenoside Fraction from *P. notoginseng*

A ginsenoside fraction from *P. notoginseng* was prepared as described in Example 9. HPLC analysis was carried using the methods and equipment described in Example 17 with the specific conditions described herein. A ginsenoside fraction sample was diluted 1/10 in HPLC-grade methanol to yield a final concentration of about 1 mg/ml. The sample injection volume was 10 μ l. The mobile phase components were as follows: mobile phase component A was phosphate buffer, 0.5% phosphoric acid in water, pH 3.5 ("A"); and, mobile phase component B was acetonitrile ("B"). The concentration gradient elution program used was as follows: the mobile phase composition from initial injection through 20 min comprised on a volume basis 79% and 21%, respectively, of A and B; and, a linear gradient from 20 to 60 min with the mobile phase changing from 79% to 58% of A and 21% to 42% of B. The total analysis time was for about 60-70 min, the mobile phase flow rate was 1 ml per min and the column temperature was controlled at 40°C. Peak detection was at 203 nm. The retention times for the designated peaks from the HPLC chromatogram are given Table 33. Additional data for representative peaks from the HPLC chromatogram are given in Table 34.

Table 33. HPLC peak retentions times from *P. notoginseng* purified ginsenoside fraction.

Peak No.	Ret Time (Min)	Peak No.	Ret Time (Min)	Peak No	Ret Time (Min)
5013	8.331	5017	25.547	5023	42.539
Rg1	9.685	5018	32.555	Rd	45.205
Re	10.720	5021	35.712	5024	47.072
5014	12.064	Rb1	37.173	5025	50.967
5015	20.011	5022	38.517	5026	59.093
5016	22.699	Rb2	42.091	5027	60.224

Table 34. HPLC data from *P. notoginseng* purified ginsenoside fraction.

Peak Name or Ref. Peak No.	Retention time (min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
GS Re	10.283	5785	3037	0.03	1692
5015	20.011	155246	2261	3.46	535
5016	22.699	84147	3496	2.79	1059
5017	25.547	65412	2102	1.35	5730
5018	32.555	308499	14232	1.05	15381
10	35.712	1038366	26800	2.36	3664
GS Rb1	37.173	84690	3550	1.06	19677
GS Rb2	42.091	210963	3385	4.46	1425
GS Rd	45.205	90094	2658	1.97	8425
5026	59.093	460812	8152	2.15	12087
5027	60.224	77037	2655	0.93	67095

EXAMPLE 23. HPLC Characterization of Ginsenoside Fraction from *P. quinquefolius*.

An affinity adsorbent purified ginsenoside fraction from *P. quinquefolius* was prepared as described in Example 10. HPLC analysis was carried out as described in Example 22. The retention times for the designated peaks from the HPLC chromatogram are given Table 35. Additional data for representative peaks from the HPLC chromatogram are given in Table 36.

Table 35. HPLC peak retention time from *P. quinquefolius* purified ginsenoside fraction.

Peak No.	Ret Time (Min)	Peak No.	Ret Time (Min)	Peak No	Ret Time (Min)
Rg1	9.984	6012	26.048	Rb2	41.963
Re	10.432	Rb1	37.387	Rd	45.685
6010	20.128	Rc	39.008	6014	49.568
6011	21.803				

Table 36. HPLC data from *P. quinquefolius* purified ginsenoside fraction.

Peak Name or Ref. Peak No.	Retention time (min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
GS Rg1	9.984	3081	0	0.06	443023
GS Re	10.432	3347571	211041	0.61	4679
6010	20.128	657342	4914	3.65	487
6011	21.803	43048	2621	0.69	15975
6012	26.048	74199	2157	1.93	2914
GS Rb1	37.387	5729502	291369	1.51	9809
GS Rc	39.008	662060	37836	1.80	7514
GS Rb2	41.963	405354	8222	3.27	2635
GS Rd	45.683	1217752	66322	1.45	15882

EXAMPLE 24. HPLC Characterization of Ginsenoside Fraction from White Ginseng (*P. ginseng*).

An affinity adsorbent purified ginsenoside fraction from white ginseng (*P. ginseng*) was prepared as described in Example 11. HPLC analysis was carried out as described in Example 22. The retention times for the designated peaks from the HPLC chromatogram are given Table 37. Additional data for representative peaks from the HPLC chromatogram are given in Table 38.

Table 37. HPLC peak retention times from white ginseng purified ginsenoside fraction.

Peak Reference No.	Retention Time (Minutes)
7010	6.635
7011	7.861
7012	8.683
7013	9.024
Re	10.272
7014	11.189
7016	12.971
7018	16.875
7020	20.725
7023	30.528
7024	32.821
7026	35.947
Rb1	38.549
Rb2	40.427
7029	42.773
7032	47.168

Table 38. HPLC data from white ginseng purified ginsenoside fraction.

Peak Name or Ref. Peak No.	Retention time (min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
GS Re	10.272	12756	2196	0.38	11691
7026	35.947	47194	2900	0.77	34871
GS Rb1	38.549	1219221	71930	2.35	4305
GS Rb2	40.427	708862	34792	1.53	11171

EXAMPLE 25. HPLC Characterization of Ginsenoside Fraction from Red Ginseng (P. ginseng).

An affinity adsorbent purified ginsenoside fraction from red ginseng (P. ginseng) was prepared as described in Example 12. HPLC analysis was carried out as described in Example 22. The retention times for the designated peaks from the HPLC chromatogram are given Table 39. Additional data for representative peaks from the HPLC chromatogram are given in Table 40.

Table 39. HPLC peak retention times from red ginseng purified ginsenoside fraction.

Peak Reference No.	Retention Time (Minutes)
Rg1	9.888
8015	11.424
Rf	29.280
8016	31.563
8017	34.635
8019	36.373
Rb1	37.152
Rc	38.987
Rb2	41.312
8022	43.904
Rd	45.675
8023	48.171
8024	57.109
8025	58.720

Table 40. HPLC data from red ginseng purified ginsenoside fraction.

Peak Name or Ref. Peak No.	Retention time (min)	Area (mAu·min)	Height (mAu)	Width (min)	Theoretical plate
GS Rg1	9.0888	720045	6280	0.39	8690
GS Rf	29.280	285743	13808	1.46	6435
8016	31.563	70436	3908	0.83	23138
8017	34.635	128707	4700	1.27	11900
8019	36.373	134854	5517	1.08	18148
GS Rb1	37.152	1208866	65256	1.77	7049
GS Rc	39.424	203364	12800	0.98	25893
GS Rb2	41.312	804060	37500	1.50	12136
GS Rd	45.675	348382	18156	1.37	17784
8024	57.109	188668	5775	1.71	17846
8025	60.128	82400	3249	1.97	14905

EXAMPLE 26. Gas Chromatograph (“GC”) and Mass Spectroscopy (“MS”) Methods.

Gas chromatographic analysis of ginseng extracts and fractions was carried using a Hewlett-Packard Model 5890 gas chromatograph. Analysis was carried out using a XTI-5 capillary column (30 m length x 0.25 mm ID, Restek) with a film thickness of 0.25 μ m and a flow rate of 1 ml/min for the helium carrier gas. The temperature of gasification was 270°C. The column temperature was programmed as follows: 50 – 140°C (held for 15 min) at a rate of 10°C/min, then held at 140°C for 15 min, followed by 140 – 260°C at a rate of 15°C/min, and then held at 260°C. The total run time was 52 min and the sample splitting time was 1:50.

Mass spectroscopy analysis was carried using a Hewlett-Packard Model 5899A mass spectrometer. The ion source temperature was 200°C, and the ion source was EI with an ionization energy of 70 eV. The emission current was 300 mA. The data was collected in full scan mode from m/z 40 – 600 in 1s cycles.

EXAMPLE 27. GC/MS Characterization of Essential Oil Fraction from *P. notoginseng*

An essential oil fraction from *P. notoginseng* was prepared as described in Example 1. Gas chromatography analysis was carried out as described in Example 26. Mass spectral analysis of peaks eluting from the GC was used to help identify the various chemical constituents. The MS data (m/z value and abundance) is consistent with the presence the following compounds in the essential oil fraction: (+)-spathulenol (espatulenol), CAS No. 6750-60-3; caffeine, CAS No. 58-08-2; hexadecanoic acid, CAS

No. 57-10-3; (-)-caryophyllene oxide, CAS No. 1139-30-6; ethyl heptanoate, CAS No. 106-30-9; *trans,trans*-octadeca-9,12-dienoic acid methyl ester, CAS No. 2566-97-4; octadec-9-ynoic acid methyl ester, CAS No. 1120-32-7; phenylacetylene, CAS No. 536-74-3; ethylenethiourea, CAS No. 96-45-7; linoleic acid, CAS No. 60-33-3; 4-methyl-pent-2-enoic acid, CAS No. 10321-71-8; 2-methyl-4-nitroimidazole, CAS No. 696-23-1; 9,12-octadecadienal, CAS No. 26537-70-2; mevinphos, CAS No. 7786-34-7; undec-10-ynoic acid, CAS No. 2777-65-3; faltarinol ((Z)- 1,9-heptadecadiene-4,6-diyn-3-ol), CAS No. 21852-80-2; and, [1R-(1 α ,4 β ,4 $\alpha\alpha$,6 β ,8 $\alpha\alpha$)]-octahydro-4,8a,9,9-tetramethyl-1,6-methano-1(2H)-naphthol, CAS No. 5986-55-0.

EXAMPLE 28. GC/MS Characterization of Essential Oil Fraction from *P. quinquefolius*.

An essential oil fraction from *P. quinquefolius* was prepared as described in Example 2. Gas chromatography analysis was carried out as described in Example 26. Mass spectral analysis of peaks eluting from the GC was used to help identify the various chemical constituents. The MS data (m/z value and abundance) is consistent with the presence the following compounds in the essential oil fraction: 4,6-diamino-1,3,5-triazin-2(1H)-one, CAS No. 645-92-1; 2,2'-methyliminodiethanol, CAS No. 105-59-9; caffeine, CAS No. 58-08-2; dihydrouracil, 504-07-4; stearic acid (octadecanoic acid), CAS No. 57-11-4; hexadecanoic acid, CAS No. 57-10-3; 4-nitrophenol, CAS No. 100-02-7; linoleic acid, CAS No. 60-33-3; 3-nitrotoluene, CAS No. 99-08-1; 2,3-dihydroxypropyl palmitate, CAS No. 542-44-9; oleic acid, CAS No. 112-80-1; cinnamyl acetate, CAS No. 103-54-8; methyl (9E,12E)-octadeca-9,12-dienoate (methyl linolelaidate), CAS No. 2566-97-4; and, 7-octenoic acid, CAS No. 18719-24-9

EXAMPLE 29. GC/MS Characterization of Essential Oil Fraction from White Ginseng (*P. ginseng*).

An essential oil fraction from white ginseng (*P. ginseng*) was prepared as described in Example 3. Gas chromatography analysis was carried out as described in Example 26. Mass spectral analysis of peaks eluting from the GC was used to help identify the various chemical constituents. The MS data (m/z value and abundance) is consistent with the presence the following compounds in the essential oil fraction: (-)-spathulenol, CAS No. 77171-55-2; (+)-spathulenol, CAS No. 6750-60-3; (-)-caryophyllene oxide, CAS No. 1139-30-6; 1-methyl-5-nitro-1H-imidazole, CAS No. 3034-42-2; 2-ethyl-2-methyloxirane, CAS No. 30095-63-7; caffeine, CAS No. 58-08-2; dihydrouracil, CAS No. 504-07-4;

hexadecanoic acid, CAS No. 57-10-3; methyl (9E,12E)-octadeca-9,12-dienoate (methyl linolelaidate), CAS No. 2566-97-4; linoleic acid, CAS No. 60-33-3; undec-10-ynoic acid, CAS No. 2777-65-3; phenylacetylene, CAS No. 536-74-3; sinalbin, CAS No. 27299-07-6; stigmasta-5,22-dien-3- β -ol, CAS No. 83-48-7; (3 β ,24S)-stigmast-5-en-3-ol, CAS No. 83-47-6; stigmast-5-en-3- β -ol, CAS No. 83-46-5; (3 β , 24 ξ)-stigmast-5-en-3-ol, CAS No. 19044-06-5; 4-methyl-1,4-heptadiene, CAS No. 13857-55-1; 9,12-octadecadienal, CAS No. 26537-70-2; 7,8-epoxyoctene, CAS No. 19600-63-6; 4-nonyne, CAS No. 20184-91-2; 2-cyclopenten-1-undecanoic acid, CAS No. 459-67-6; falcarinol ((Z)- 1,9-heptadecadiene-4,6-diyn-3-ol), CAS No. 21852-80-2; and, N-methylcaprolactam, CAS No. 2556-73-2.

EXAMPLE 30. GC/MS Characterization of Essential Oil Fraction from Red Ginseng (*P. ginseng*).

An essential oil fraction from red ginseng (*P. ginseng*) was prepared as described in Example 3. Gas chromatography analysis was carried out as described in Example 26. Mass spectral analysis of peaks eluting from the GC was used to help identify the various chemical constituents. The MS data (*m/z* value and abundance) is consistent with the presence the following compounds in the essential oil fraction: 3-hydroxy-2-methyl-4-pyrone, CAS No. 118-71-8; pyrogallol, CAS No. 87-66-1; [1aR-(1 α ,7 α ,7 α ,7 β)]-1a,2,3,5,6,7,7a,7b-octahydro-1,1,7,7a-tetramethyl-1H-cyclopropa[a]naphthalene, CAS No. 17334-55-3; [1aR-(1 α ,4 α ,7 α ,7 β ,7 β)]-decahydro-1,1,7-trimethyl-4-methylene-1H-cycloprop[e]azulene, CAS No. 489-39-4; caryophyllene, CAS No. 87-44-5; 1R-(1R*,4Z,9S*)]-4,11,11-trimethyl-8-methylenebicyclo[7.2.0]undec-4-ene, CAS No. 118-65-0; caffeine, CAS No. 58-08-2; hexadecanoic acid, CAS No. 57-10-3; 4-methyl-2-phenyl-2-pentenal, CAS No. 26643-91-4; (Z)-9,17-Octadecadienal, CAS No. 56554-35-9; linoleic acid, CAS No. 60-33-3; ethylidenecycloheptane, CAS No. 10494-87-8; Octa-1,7-diyn, CAS No. 871-84-1; 3-(phenylmethyl)sydnone, CAS No. 16844-42-1; phenylacetylene, 536-74-3; diisopropyl adipate, CAS No. 6938-94-9; 2,3-dihydroxypropyl palmitate, CAS No. 542-44-9; 9Z,12Z-octadecadienoic acid (2-linoleoyl glycerol), CAS No. 3443-82-1; and, 3-ethenyl-cyclooctene, CAS No. 2213-60-7.

EXAMPLE 31. Determination of Polysaccharide Concentration in the *Panax* species Purified Polysaccharide Fraction

All of the dried polysaccharide extracts from *P. notoginseng* (Example 13), *P. quinquefolius* (Example 14), white ginseng (Example 15), and red ginseng (16) were

colorless indicating that the tannins and other polyphenolic chemical constituents were extracted with ethanol during the extraction of the ginsenosides (Step 2). When various amounts of salts (up to 100 mg/2 gm (solution dry mass weight) as well as citric acid and acetic acid were added to the polysaccharide extract solutions, no precipitate was observed indicating that the protein content of the polysaccharide extract fractions were low. Furthermore, dissolving the freeze-dried polysaccharide extract fractions in 10 volumes of ethanol revealed that less than 1% of the polysaccharide extract fractions were soluble in ethanol. Therefore, these *Panax* species polysaccharide extract fractions were highly purified, probably greater than 99%, mixtures of polysaccharides of various molecular weights.

More directly, the amount of carbohydrate in all of the purified polysaccharide fractions were determined using the anthrone colorimetric method. Typically, about 0.18 gram of anthrone (CAS No. 90-44-8, obtained from Sigma-Aldrich), which is also called 9,10-dihydro-9-oxoanthracene, was mixed with about 50 ml of concentrated sulfuric acid, (95.7%, obtained from Fisher). The solution of anthrone and sulfuric acid was shaken and then immersed in an ice water bath. Calibration of the spectrophotometer (Thermo Spectronic 20D+) was accomplished using lactose (CAS No. 63-42-3, obtained from Acros) as a standard. A lactose standard solution (0.05% wt/vol) was prepared by dissolving about 15 mg of lactose in about 30 ml of distilled water. Specific volumes of the lactose standard solutions (typically about 0, 200, 400, 600, and 800 μ l) were pipetted into test tubes, and the volume was adjusted to a final volume of 1 ml using distilled water. Anthrone solution (2 ml), prepared as described above, was gradually added to each 1 ml lactose standard samples while the test tube was vigorously shaken. Following mixing, the anthrone – sample solutions were then stored in an ice bath for 30 minutes, followed by warming to room temperature. The absorbance of each sample was determined at 625 nm using distilled water as a blank. The absorbance was plotted versus the concentration of lactose to obtain a standard curve. Samples of the purified polysaccharide fractions (about 10 μ l) were diluted to 1 ml with distilled water. To the diluted polysaccharide samples was gradually added about 2 ml of the anthrone reagent with vigorous shaking. Following mixing, the anthrone – polysaccharide solutions were stored for 30 minutes in an ice bath, and then warmed to room temperature. The absorbance at 625 nm was determined for each anthrone – polysaccharide sample solutions. The amount of carbohydrate in each sample was determined using the lactose standard curve prepared as described above. Typically,

using this method, it was determined that all of the polysaccharides fraction derived from all of the *Panax* species studied contained greater than 90% by weight carbohydrate components.

EXAMPLE 32. *P. notoginseng* Extract Dosage Form Composition.

An extract of *P. notoginseng* was prepared according to the present invention and used to prepare a dosage form composition suitable for tablets, capsules, or powder for addition to water or other solution as a drinkable solution. The dosage form composition was prepared according to the formulation given in Table 41, wherein the amounts given are the amounts per single dosage form.

Table 41. *P. notoginseng* formulation composition.

Extract of <i>P. notoginseng</i>	150.0 mg
Essential Oil (2 mg, 1.3% dry weight)	
Total Ginsenosides (38 mg, 25.3% dry weight)	
Polysaccharides (110 mg, 73.3% dry weight)	
Stevioside (Extract of Stevia)	12.5 mg
Carboxymethylcellulose	35.5 mg
Lactose	77.0 mg
TOTAL	275.0 mg

The novel extract of *P. notoginseng* comprises an essential oil, ginsenosides, and polysaccharides by percentage mass weight greater than that found in the natural rhizome material or convention extraction products. The formulations can be made into any oral dosage form and administered daily or to 15 times per day as needed for the physiological, psychological and medical effects desired (enhanced memory and cognition, relief from chronic fatigue syndrome, enhancement of male erectile function) and medical effects (anti-oxidation, anti-platelet aggregation, cardiovascular and cerebrovascular disease prevention and treatment, anti-hypercholesterolemia, cytoprotection, nervous system protection, neurological degenerative disease such as Alzheimer's and Parkinson's disease prevention and treatment, anti-inflammatory, immune enhancement, anti-viral, pulmonary disease, hepatic protection and diseases, hypoglycemic and anti-diabetes, and cancer prophylaxis and treatment). The dosage composition as provided in Table 41 may be compressed into a tablet, used in a gelcap, or used in a fast-dissolve table.

EXAMPLE 33. *P. quinquefolius* Extract Dosage Form Composition

An extract of *P. quinquefolius* was prepared according to the present invention and

used to prepare a dosage form composition suitable for tablets, capsules, or powder for addition to water or other solution as a drinkable solution. The dosage form composition was prepared according to the formulation given in Table 42, wherein the amounts given are the amounts per single dosage form.

Table 42. *P. quinquefolius* formulation composition.

Extract of <i>P. quinquefolius</i>	150.0 mg
Essential Oil (2.0 mg, 1.3% dry weight)	
Total Ginsenosides (20.0 mg, 13.3% dry weight)	
Polysaccharides (128.0 mg, 85.4% dry weight)	
Vitamin C	15.0 mg
Sucralose	35.0 mg
Mung bean powder (10:1)	50.0 mg
Mocha flavor	40.0 mg
Flavor (Chocolate, strawberry, mocha, etc.)	10.0 mg
TOTAL	300.0 mg

Mung Bean Powder 10:1 refers to water content (10 parts Mung Bean to 1 part water). It is used as a binder.

The novel extract composition of *P. quinquefolius* comprises an essential oil, ginsenosides, and polysaccharide chemical constituents by % mass weight greater than that found in the natural plant material or conventional extraction products. The formulation can be made into any oral dosage form and administered safely up to 15 times per day as needed for the physiological, psychological and medical effects desired (see Example 1, above). The dosage composition as provided in Table 42 may be compressed into a tablet, used in a gelcap, or used in a fast-dissolve table.

EXAMPLE 34. White Ginseng (*P. ginseng*) Extract Dosage Form Composition.

An extract of white ginseng (*P. ginseng*) was prepared according to the present invention and used to prepare a dosage form composition suitable for tablets, capsules, or powder for addition to water or other solution as a drinkable solution. The dosage form composition was prepared according to the formulation given in Table 43, wherein the amounts given are the amounts per single dosage form.

Table 43. White ginseng formulation composition.

Extract of White Ginseng (<i>P. ginseng</i>)	150.0 mg
Essential Oil (5.0 mg, 3.3% dry weight)	
Total Ginsenosides (45.0 mg, 30.0% dry weight)	

Polysaccharides (100.0 mg, 66.7% dry weight)	
Vitamin C	15.0 mg
Sucralose	35.0 mg
Mung bean powder (10:1)	30.0 mg
Flavor (Strawberry)	60.0 mg
X-base M-500	54.0 mg
X-base Xanthan gum	1.0 mg
TOTAL	350.0 mg

The novel extract composition of White Ginseng (*P. ginseng*) comprises an essential oil, ginsenosides, and polysaccharides chemical constituents by % mass weight greater than that found in the natural plant material or conventional extraction products. Note also the profile change in the White Ginseng extract composition (the essential oil/ginsenosides ratio in feedstock was 1/6.4 and in extract composition is 1/5; the essential oil/polysaccharides ratio in feedstock was 1/35 and in the extract composition is 1/20; and the ginsenosides/polysaccharides ratios was 1/5.4 and the extract composition is 1/4). The formulation can be made into any oral dosage for and administered safely up to 15 times per day as needed for the physiological, psychological, and medical effects desired (see Example 1, above). The dosage composition as provided in Table 43 may be compressed into a tablet, used in a gelcap, or used in a fast-dissolve table.

Whereas this invention has been described in detail with particular reference to specific embodiments, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention in light of the above teachings without departing from the scope or spirit of the invention. Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered exemplary only, with a true scope and spirit of the invention being indicated by the following claims.

REFERENCES

U.S. PATENT Nos.: 3,464,972; 3,883,425; 3,886,272; 3,901,875; 4,157,894; 5,776,460; 6,432,454;

1. Sticher O. Chemtech 28(4):26, 1998.
2. Tang G and Eisenbrand G. Chinese Drugs of Plant Origin, Springer-Verlag: New York, 1984 Vol.46:1.

3. Shibata S et al. In: Economic and Medicinal Plant Research; Wagner H et al (eds); Academic Press: London, 1985; Vol. 1:217.
4. Zhang S et al. *Planta Med* 56:298, 1990.
5. Liu C-X and Xiao P-G. *J Ethnopharmacol* 36:27, 1992.
6. Sonnenborn U. *Dtsch Apoth Ztg* 127:433, 1987.
7. Sonnenborn U. Proppert, Y Z *Phytother* 11:35, 1990.
8. Soldati F and Sticher O. *Planta Med* 39:348, 1980.
9. Angell M and Kassirer JP. *N Engl J Med* 339:839, 1998.
10. Hershey MR et al. *Am J Clin Nutr* 73(6):1101, 2001.
11. Deng HW et al. *Biochem Arch* 6:359, 1990.
12. Deng H and Zang J. *Chin Med J* 104:395, 1991.
13. Lee SJ et al. *Cancer Lett* 144(1):39, 1999.
14. Maffei F et al. *Planta Med* 65(7):614, 1999.
15. Voces J et al. *Comp Biochem Physiol C Pharmacol Toxicol Endocrinol* 123(2):175, 1999.
16. Chang TO. *Arch Intern Med* 160:3329, 2000.
17. Lee JY et al. *Life Sci* 75f(13):1621, 2004
18. Zhen SY et al. *Zhougguo Zhong Xi Yi Jie He Za Zhi*. 24(6):541, 2004.
19. Shao ZH et al. *Biochim Biophys Acta*. 1670(3):165, 2004.
20. Sui DY et al. *Zhongguo Zhong Yao Za Zhi*. 26(6):416, 2001.
21. Caron MF et al. *Ann Pharmacother*. 36(5):758, 2002
22. Gao Q et al. *Planta Med* 55:9, 1989.
23. Yamada H and Kiyhara H. *Abstr Chin Med* 3:104, 1989.
24. Tomoda M et al. *Biol Pharm Bull* 16:22, 1993.
25. Tomoda M et al. *Biol Pharm Bull* 17:1287, 1994.
26. Tomoda M et al. *Biol Pharm Bull* 16:1087, 1993.

27. Liu J et al. Ageing Dev 83:43, 1995.
28. Yamada H et al. Phytother Res 9:264, 1995.
29. Wang M et al. J Pharm Pharmacol. 53(11):1515, 2001.
30. Yoshikawa M et al. Chem Pharm Bull (Tokyo). 49(11):1452, 2001.
31. Shin JY et al. Immunopharmacol Immunotoxicol. 24(3):469, 2002.
32. Rivera E et al. Vaccine 21(11-12):1149, 2003.
33. Sun HX et al. Acta Pharmacol Sin. 24(11):1150, 2003.
34. McElhaney JE et al. J Am Geriatr Soc. 52(1):13, 2004.
35. Sun X-B et al. J Ethnopharmacol 31:101, 1991.
36. Wen T-C et al. Acta Neuropath 91:15, 1996.
37. Rudakewich M et al. Planta Med. 67(6):533, 2001.
38. Lee TF et al. Planta Med. 67(7):634, 2001.
39. Liao B et al. Exp Neurol. 173(2):224, 2002.
40. Van Kampen J et al. Exp Neurol. 184(1):521, 2003.
41. Kimura Y et al. J Pharm Pharmacol 40:838, 1988.
42. Teng C-M et al. Biochem Biophys Acta 990:315, 1989.
43. Kuo S-C et al. Planta Med 56:164, 1990.
44. Liu T et al. Zhongguo Zhong Yao Za Zhi. 27(8):609, 2002.
45. Nah S-Y et al. Proc Natl Acad Sci 92:8739, 1995.
46. Ahn B-Z and Kim S-I. Arch Pharm 321:61, 1988.
47. Matsunaga H et al. Chem Pharm Bull 37:1279, 1989.
48. Matsunaga H et al. Chem Pharm Bull 38:3480, 1990.
49. Matsunaga H et al. Cancer Chemother Pharmacol 35:291, 1995.
50. Mochizuki M et al. Biol Pharm Bull 18:1197, 1995.
51. Fei XF et al. Acta Pharmacol Sin. 23(4):315, 2002.
52. Yun TK et al. J Korean Med Sci. 16:S6,2001.

53. Ro JY et al. *Int J Immunopharmacol*. 20(11):625, 1998.
54. Cabral de Oliveira AC et al. *Comp Biochem Physiol C Toxicol Pharmacol*. 30(3):369, 2001.
55. Inoue M et al. *Phytomed* 6(4):257, 1999.
56. Kim SH and Park KS. *Pharmacol Res*. 48(5):511, 2003.
57. Sotaniemi E et al. *Diabete Care* 18(10):1373, 1995.
58. Dey L et al. *Phytomedicine* 10(6-7):2003.
59. Bae JW and Lee MH. *J Ethnopharmacol* 91(1):137, 2004.
60. Xie JT et al. *Phytomedicine* 11(2-3):182, 2004.
61. Gross D et al. *Monaldi Arch Chest Dis*. 57(5-6):242, 2002.
62. Lin CF et al. *Phytother Res*. 17(9):1119, 2003.
63. Park EJ et al. *Basic Clin Pharmacol Toxicol*. 94(3):298, 2004.
64. Choi H et al. *Int J Impot Res*. 7(3):935, 1991.
65. Choi H et al. *J Urol*. 162(4):1508, 1999.
66. Murphy LL and Lee TJ. *Ann N Y Acad Sci*. 962:372, 2002.
67. Hong B et al. *J Urol*. 168(5):2070, 2002.
68. Yamazaki M et al. *Biol Pharm Bull*. 24(2):1434, 2001.
69. Scholey AB and Kennedy DO. *Hum Psychopharmacol*. 17(1):35, 2002.
70. Hartz AJ et al. *Psychol Med*. 34(1):51, 2004.
71. Fulder SJ et al. *Proc 4th Int Ginseng Symposium* 4:215-223, 1984.
72. Yun YS et al. *Plant Med* 59:521, 1993.
73. Kim K-H et al. *Planta Med* 64:110, 1998.
74. Lee Y-S et al. *Anticancer Res* 17:323, 1997.

CLAIMS

What is claimed is:

1. A composition comprising a ginsenoside in an amount greater than 10% by weight.
2. The composition of claim 1, wherein the ginsenoside comprises R₀, R₁, R₂, R_a, R_{b1}, R_{b2}, R_c, R_d, R_e, R_f, R_{g1}, R_{g2}, R_{g3}, R_{g5}, R_{h1}, R_{h2}, R_{h4}, R_{s1}, R_{s2}, R_{s3}, or R_{s4}.
3. The composition of claim 1, wherein the amount of ginsenoside is greater than 15, 20, 25, 30, 35, 40, 45 or 50% by weight.
4. The composition of claim 1, further comprising a polyacetylene.
5. The composition of claim 4, wherein the polyacetylene comprises pananaxynol, panaxydol, panaxytriol, acetylpanaxydol, chloropapaxydol, panaxydolchlorohydrin, panaxyne, ginsenoyne A, ginsenoyne B, ginsenoyne C, ginsenoyne D, ginsenoyne E, ginsenoyne F, ginsenoyne G, ginsenoyne H, ginsenoyne I, ginsenoyne J, or ginsenoyne K.
6. The composition of claim 4, wherein the polyacetylene comprises pananaxynol, panaxydol, panaxytriol, acetylpanaxydol, chloropapaxydol, panaxydolchlorohydrin, panaxyne, ginsenoyne A, ginsenoyne B, ginsenoyne C, ginsenoyne D, ginsenoyne E, ginsenoyne F, ginsenoyne G, ginsenoyne H, ginsenoyne I, ginsenoyne J, and ginsenoyne K.
7. The composition of claim 4, wherein the ginsenoside comprises R₀, R₁, R₂, R_a, R_{b1}, R_{b2}, R_c, R_d, R_e, R_f, R_{g1}, R_{g2}, R_{g3}, R_{g5}, R_{h1}, R_{h2}, R_{h4}, R_{s1}, R_{s2}, R_{s3}, or R_{s4}.
8. The composition of claim 4, wherein the amount of ginsenoside is greater than 15, 20, 25, 30, 35, 40, 45 or 50% by weight.
9. The composition of claim 4, wherein the amount of polyacetylene is 1, 2, 4, 6, 8, or 10% by weight.
10. The composition of claim 4, further comprising an essential oil selected from the group consisting of (+)-spathulenol; (-)-spathulenol; caffeine; hexadecanoic acid; (-)-caryophyllene oxide; ethyl heptanoate; *trans,trans*-octadeca-9,12-dienoic acid methyl ester; octadec-9-ynoic acid methyl ester; phenylacetylene; ethylenethiourea; linoleic acid; 4-methyl-pent-2-enoic acid; 2-methyl-4-nitroimidazole; 9,12-octadecadienal; mevinphos; undec-10-ynoic acid; falcarinol ((Z)-1,9-

heptadecadiene-4,6-diyn-3-ol); [1R-(1 α ,4 β ,4 $\alpha\alpha$,6 β ,8 $\alpha\alpha$)]-octahydro-4,8a,9,9-tetramethyl-1,6-methano-1(2H)-naphthol; 4,6-diamino-1,3,5-triazin-2(1H)-one; 2,2'-methyliminodiethanol; dihydrouracil; stearic acid; 4-nitrophenol; 3-nitrotoluene; 2,3-dihydroxypropyl palmitate; oleic acid; cinnamyl acetate; 7-octenoic acid; 1-methyl-5-nitro-1H-imidazole; 2-ethyl-2-methyloxirane; methyl (9E,12E)-octadeca-9,12-dienoate; sinalbin, stigmasta-5,22-dien-3- β -ol; (3 β ,24S)-stigmast-5-en-3-ol; stigmast-5-en-3- β -ol; (3 β , 24 ξ)-stigmast-5-en-3-ol; 4-methyl-1,4-heptadiene; 9,12-octadecadienal; 7,8-epoxyoctene, 4-nonyne; 2-cyclopenten-1-undecanoic acid; 3-hydroxy-2-methyl-4-pyrone; pyrogallol; [1aR-(1 $\alpha\alpha$,7 α ,7 $\alpha\alpha$,7 $\beta\alpha$)]-1a,2,3,5,6,7,7a,7b-octahydro-1,1,7,7a-tetramethyl-1H-cyclopropa[a]naphthalene; [1aR-(1 $\alpha\alpha$,4 $\alpha\alpha$,7 α ,7a β ,7 $\beta\alpha$)]-decahydro-1,1,7-trimethyl-4-methylene-1H-cycloprop[e]azulene; caryophyllene; 1R-(1R*,4Z,9S*)]-4,11,11-trimethyl-8-methylenebicyclo[7.2.0]undec-4-ene; 4-methyl-2-phenyl-2-pentenal; (Z)-9,17-octadecadienal; ethylidenecycloheptane; octa-1,7-diyne; 3-(phenylmethyl)sydnone; diisopropyl adipate; 2,3-dihydroxypropyl palmitate; 9Z,12Z-octadecadienoic acid (2-linoleoyl glycerol); and 3-ethenyl-cyclooctene.

11. The composition of claim 1, further comprising a polysaccharide.
12. The composition of claim 11, wherein the polysaccharide comprises glucose, arabinose, galactose, rhamnose, xylose or uronic acid.
13. The composition of claim 11, wherein the polysaccharide comprises glucose, arabinose, galactose, rhamnose, xylose and uronic acid.
14. The composition of claim 11, wherein the ginsenoside comprises R₀, R₁, R₂, R_a, R_{b1}, R_{b2}, R_c, R_d, R_e, R_f, R_{g1}, R_{g2}, R_{g3}, R_{g5}, R_{h1}, R_{h2}, R_{h4}, R_{s1}, R_{s2}, R_{s3}, or R_{s4}.
15. The composition of claim 11, wherein the amount of ginsenosides is greater than 15, 20, 25, 30, 35, 40, 45 or 50% by weight.
16. The composition of claim 11, wherein the amount of polysaccharide is 25, 30, 35, 40, 45, 50, 55, or 60% by weight.
17. The composition of claim 11, further comprising an essential oil selected from the group consisting of (+)-spathulenol; (-)-spathulenol; caffeine; hexadecanoic acid; (-)-caryophyllene oxide; ethyl heptanoate; *trans,trans*-octadeca-9,12-dienoic acid methyl ester; octadec-9-ynoic acid methyl ester; phenylacetylene; ethylenethiourea;

- linoleic acid; 4-methyl-pent-2-enoic acid; 2-methyl-4-nitroimidazole; 9,12-octadecadienal; mevinphos; undec-10-ynoic acid; falcarinol ((Z)-1,9-heptadecadiene-4,6-diyn-3-ol); [1R-(1 α ,4 β ,4 $\alpha\alpha$,6 β ,8 $\alpha\alpha$)]-octahydro-4,8a,9,9-tetramethyl-1,6-methano-1(2H)-naphthol; 4,6-diamino-1,3,5-triazin-2(1H)-one; 2,2'-methyliminodiethanol; dihydrouracil; stearic acid; 4-nitrophenol; 3-nitrotoluene; 2,3-dihydroxypropyl palmitate; oleic acid; cinnamyl acetate; 7-octenoic acid; 1-methyl-5-nitro-1H-imidazole; 2-ethyl-2-methyloxirane; methyl (9E,12E)-octadeca-9,12-dienoate; sinalbin, stigmasta-5,22-dien-3- β -ol; (3 β ,24S)-stigmast-5-en-3-ol; stigmast-5-en-3- β -ol; (3 β , 24 ξ)-stigmast-5-en-3-ol; 4-methyl-1,4-heptadiene; 9,12-octadecadienal; 7,8-epoxyoctene, 4-nonyne; 2-cyclopenten-1-undecanoic acid; 3-hydroxy-2-methyl-4-pyrone; pyrogallol; [1aR-(1 $\alpha\alpha$,7 α ,7 $\alpha\alpha$,7 $\beta\alpha$)]-1a,2,3,5,6,7,7a,7b-octahydro-1,1,7,7a-tetramethyl-1H-cyclopropa[a]naphthalene; [1aR-(1 $\alpha\alpha$,4 $\alpha\alpha$,7 α ,7 α β ,7 $\beta\alpha$)]-decahydro-1,1,7-trimethyl-4-methylene-1H-cycloprop[e]azulene; caryophyllene; 1R-(1R*,4Z,9S*)]-4,11,11-trimethyl-8-methylenebicyclo[7.2.0]undec-4-ene; 4-methyl-2-phenyl-2-pentenal; (Z)-9,17-octadecadienal; ethylidenecycloheptane; octa-1,7-diyne; 3-(phenylmethyl)sydnone; diisopropyl adipate; 2,3-dihydroxypropyl palmitate; 9Z,12Z-octadecadienoic acid (2-linoleoyl glycerol); and 3-ethenyl-cyclooctene.
18. The composition of claim 1, further comprising a polyacetylene and a polysaccharide.
 19. The composition of claim 18, wherein the ginsenoside comprises R₀, R₁, R₂, R_a, R_{b1}, R_{b2}, R_c, R_d, R_e, R_f, R_{g1}, R_{g2}, R_{g3}, R_{g5}, R_{h1}, R_{h2}, R_{h4}, R_{s1}, R_{s2}, R_{s3}, or R_{s4}.
 20. The composition of claim 18, wherein the amount of ginsenoside is greater than 15, 20, 25, 30, 35, 40, 45 or 50% by weight.
 21. The composition of claim 18, wherein the polyacetylene comprises pananaxynol, panaxydol, panaxytriol, acetylpanaxydol, chloropapaxydol, panaxydolchlorohydrin, panaxyne, ginsenoyne A, ginsenoyne B, ginsenoyne C, ginsenoyne D, ginsenoyne E, ginsenoyne F, ginsenoyne G, ginsenoyne H, ginsenoyne I, ginsenoyne J, or ginsenoyne K.
 22. The composition of claim 18, wherein the polyacetylene comprises pananaxynol, panaxydol, panaxytriol, acetylpanaxydol, chloropapaxydol, panaxydolchlorohydrin, panaxyne, ginsenoyne A, ginsenoyne B, ginsenoyne C, ginsenoyne D, ginsenoyne

E, ginsenoyne F, ginsenoyne G, ginsenoyne H, ginsenoyne I, ginsenoyne J, and ginsenoyne K.

23. The composition of claim 18, wherein the amount of polyacetylene is 1, 2, 4, 6, 8, or 10% by weight.
24. The composition of claim 18, wherein the polysaccharide comprises glucose, arabinose, galactose, rhamnose, xylose or uronic acid.
25. The composition of claim 18, wherein the polysaccharide comprises glucose, arabinose, galactose, rhamnose, xylose and uronic acid.
26. The composition of claim 18, wherein the amount of polysaccharide is 25, 30, 35, 40, 45, 50, 55, or 60% by weight.
27. The composition of claim 18, further comprising an essential oil selected from the group consisting of (+)-spathulenol; (-)-spathulenol; caffeine; hexadecanoic acid; (-)-caryophyllene oxide; ethyl heptanoate; *trans,trans*-octadeca-9,12-dienoic acid methyl ester; octadec-9-ynoic acid methyl ester; phenylacetylene; ethylenethiourea; linoleic acid; 4-methyl-pent-2-enoic acid; 2-methyl-4-nitroimidazole; 9,12-octadecadienal; mevinphos; undec-10-ynoic acid; falcarinol ((Z)-1,9-heptadecadiene-4,6-diyn-3-ol); [1R-(1 α ,4 β ,4 $\alpha\alpha$,6 β ,8 $\alpha\alpha$)]-octahydro-4,8a,9,9-tetramethyl-1,6-methano-1(2H)-naphthol; 4,6-diamino-1,3,5-triazin-2(1H)-one; 2,2'-methyliminodiethanol; dihydrouracil; stearic acid; 4-nitrophenol; 3-nitrotoluene; 2,3-dihydroxypropyl palmitate; oleic acid; cinnamyl acetate; 7-octenoic acid; 1-methyl-5-nitro-1H-imidazole; 2-ethyl-2-methyloxirane; methyl (9E,12E)-octadeca-9,12-dienoate; sinalbin, stigmasta-5,22-dien-3- β -ol; (3 β ,24S)-stigmast-5-en-3-ol; stigmast-5-en-3- β -ol; (3 β , 24 ξ)-stigmast-5-en-3-ol; 4-methyl-1,4-heptadiene; 9,12-octadecadienal; 7,8-epoxyoctene, 4-nonyne; 2-cyclopenten-1-undecanoic acid; 3-hydroxy-2-methyl-4-pyrone; pyrogallol; [1aR-(1 $\alpha\alpha$,7 α ,7 $\alpha\alpha$,7 $\beta\alpha$)]-1a,2,3,5,6,7,7a,7b-octahydro-1,1,7,7a-tetramethyl-1H-cyclopropa[a]naphthalene; [1aR-(1 $\alpha\alpha$,4 $\alpha\alpha$,7 α ,7a β ,7 $\beta\alpha$)]-decahydro-1,1,7-trimethyl-4-methylene-1H-cycloprop[e]azulene; caryophyllene; 1R-(1R*,4Z,9S*)]-4,11,11-trimethyl-8-methylenebicyclo[7.2.0]undec-4-ene; 4-methyl-2-phenyl-2-pentenal; (Z)-9,17-octadecadienal; ethylenecycloheptane; octa-1,7-diyne; 3-(phenylmethyl)sydnone; diisopropyl adipate; 2,3-dihydroxypropyl palmitate; 9Z,12Z-octadecadienoic acid (2-linoleoyl glycerol); and 3-ethenyl-cyclooctene.

28. The composition of claim 1, 4, 11, or 18, further comprising a pharmaceutical carrier.
29. A method for extracting a Panax species comprising, sequentially extracting a Panax species plant material to yield an essential oil fraction, a ginsenoside fraction and a polysaccharide fraction, wherein the essential oil fraction is derived by extracting plant feedstock material by supercritical carbon dioxide extraction, the ginsenoside fraction is extracted from the remainder of the essential oil extraction by hydroalcoholic extraction, and the polysaccharide fraction is derived by hot water extraction of the remainder of the ginsenoside extraction.
30. The method of claim 29, wherein ginsenoside extraction comprises:
 - a) contacting a remainder of a feedstock material from an extraction of an essential oil extraction by supercritical carbon dioxide with a hydroalcoholic mixture for a time sufficient to extract ginsenosides to form an aqueous solution of extracted ginsenosides;
 - b) passing the aqueous solution of extracted ginsenosides through an adsorbent resin column wherein the ginsenosides are adsorbed; and
 - c) eluting the ginsenosides from adsorbent resin.