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No. 14 July 2010

Antioxidant Herbs to Support Health & Vitality

Key Points at a Glance

Oxidative Stress & Detoxification

- oxidative stress may be a factor in or a cause of many diseases
- antioxidants may delay or prevent oxidative damage in tissues
- detoxification involves phase I and phase II reactions (by the action of enzymes)
- antioxidants and phase II activity may also contribute to chemoprevention

Grape Seed Extract

- contains oligomeric procyanidins (OPCs)
- antioxidant (human studies)
- supports connective tissue (*in vitro*)
- anti-inflammatory and chemopreventive (experimental models)
- clinically demonstrated to:
  - increase capillary resistance
  - improve venous insufficiency and retinopathic lesions
  - reduce oedema
  - decrease blood pressure in metabolic syndrome
  - improve bowel flora

Turmeric

- traditionally used as a tonic, for liver and skin disorders, to improve bowel flora
- contains yellow pigments including curcumin
- antioxidant (human studies)
- chemopreventive, and synergistic activity of curcumin with green tea catechins; induces phase II enzymes (experimental models)
- clinically demonstrated to:
  - improve lipids and fibrinogen in those with elevated levels
  - reduce excretion of mutagens and reduce precancerous oral lesions in smokers
  - epidemiological study suggests association with better cognitive function

Green Tea

- traditionally used as a tonic and cognition enhancer
- contains catechins
- antioxidant (human studies)
- epidemiological studies show association for reduced:
  - LDL-cholesterol level, risk of stroke, subarachnoid haemorrhage and coronary artery disease, mortality for some conditions (such as cardiovascular disease), incidence of myocardial infarction, risk of developing hypertension
  - incidence of liver, ovarian, prostate and oral cancer (prostate cancer: includes clinical trial data, high dose of catechins (600 mg/day)); risk of haematological malignancies and leukaemia
  - DNA damage in smokers
  - risk of cognitive impairment, risk of depression or distress
  - dosage hard to assess but probably requires at least 250 mg/day of catechins
- clinically demonstrated to improve atherosclerosis markers and bowel flora
- hepatotoxicity associated with ethanol extracts (some case reports)

Rosemary

- traditionally used to support liver function and circulation
- strong antioxidant (experimental models)
- supports phase I/II enzyme activity (experimental models)

Oxidative Stress

Free radicals are molecules that contain one or more unpaired electrons, hence they are highly reactive. They are generated in biological systems under normal conditions (such as metabolic processes, physical exercise), pathological events (such as trauma, infections, inflammation, ischaemia) and from external sources (cigarette smoke, alcohol, drugs, pollution). In addition to free radicals, the body generates oxidising agents that can produce free radicals.[1,2] For simplicity these are referred to as oxidants.

Oxidative stress has been defined as is a disturbance in the balance between the production of oxidants and the body's antioxidant defences, potentially leading to cellular damage. Lipids, proteins, carbohydrates and DNA are targets of oxidants. Oxidative stress may be a factor in, or

be a cause and/or consequence of many human diseases, including for example, cardiovascular disease, neurodegenerative disease, chronic inflammatory disease, some cancers and some types of gastrointestinal disease.[2-4] An antioxidant can be defined as any substance that delays, prevents or removes oxidative damage to a target molecule.[5] Glutathione and superoxide dismutase are examples of endogenous antioxidants.

Evidence suggests that the activity of antioxidants demonstrated *in vitro* cannot necessarily be translated into physiological effects *in vivo*.[4,6] It is suggested that as a single assay gives unreliable results, several parameters of oxidative stress should be assessed to confirm the activity.[3] Some assays are considered more reliable than others e.g. F_2-isoprostanes are considered more suitable for measurement of lipid peroxidation than thiobarbituric acid reactive substances (TBARS), malonaldehyde or conjugated dienes.[7]

Detoxification

The metabolic detoxification (biotransformation) of drugs, toxins and endogenous compounds (e.g. hormones) in the body involves phase I and phase II reactions in the liver to prepare the compound for excretion. The phase I and II reactions are usually achieved by the action of enzymes.

Phase I
• as a first step the toxin is made more reactive (and sometimes more toxic) • involves oxidation and reduction; may involve the generation of free radicals • the main enzymes associated with these reactions are the cytochrome P450s
Phase II
• a substance is then added on (e.g. sulphate, glucuronide), making the toxin more water soluble and ready for excretion in urine or bile • can be thought of as detoxifying the products of phase I reactions • if the toxin is sufficiently reactive, phase I is bypassed • examples of phase II enzymes: glutathione S-transferases, NAD(P)H:quinone reductase
Balance
• excess of phase I over phase II may lead to higher levels of free radicals and reactive intermediates, capable of binding to cell macromolecules (e.g. DNA) with potential negative consequences including carcinogenesis, hepatotoxicity • stimulation of phase I reactions may lead to drug interactions
Factors affecting Metabolic Detoxification
• genetics: rapid and slow response for phase I and phase II enzymes • age: very young (e.g. incomplete development of phase II) and elderly (decreased activity of phase I enzymes; decreased hepatic blood flow) • disease, especially liver disease, and conditions associated with decreased hepatic blood flow

Antioxidants may help neutralise increased free radical formation, particularly in the liver, if there is greater phase I activity. Substances that stimulate only phase II may be beneficial, although for the best detoxification stimulation of both phase I and II is recommended.

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Grape Seed

Grape Seed extract is obtained from the seeds of red or white grapes (*Vitis vinifera*) and contains oligomeric procyanidins (OPCs) which are made up of 2, 3 or 4 units of catechin and epicatechin.[8]

In vitro studies confirm that oligomeric procyanidins from Grape Seed support connective tissue by protecting the collagen and elastin within the microvessel wall, facilitate the formation of collagen microfibrils and help collagen construct crosslinks (which aids the stability of the connective tissue).[8-10]

Oral administration of Grape Seed extract has been shown to have anti-inflammatory and chemopreventive activity in experimental models.[11-16]

Clinical Studies

Antioxidant Activity

Refer to Table 1 for antioxidant activity of Grape Seed extract in healthy volunteers and patients.

Capillary Disorders, Retinopathy

In uncontrolled and controlled trials, Grape Seed extract (100-150 mg/day of OPCs) **increased capillary resistance** in a range of conditions where capillary fragility, low capillary resistance or functional venous problems were present. In addition to poor capillary fragility and venous insufficiency, some patients had varicose veins and leg ulcers. Diabetic and hypertensive patients were assessed in one trial.[17-23] In patients with venous insufficiency, symptoms such as swelling, itching, pain, heaviness in the legs were alleviated or resolved.[21,23]

Patients with retinopathy experienced a **reduction in oedema** and some improvement in capillary resistance (uncontrolled trials, 100-200 mg/day of OPCs).[24,25] **Retinopathic lesions were stabilised** in 80% of patients taking Grape Seed extract (150 mg/day of OPCs) compared to 46% of patients taking placebo.[26]

Abbreviations: 4-HNE: 4-hydroxy-2(E)-nonenal; 8-OHdG: 8-hydroxydeoxyguanosine; AST: aspartate aminotransferase; Band 3: a red blood cell transmembrane protein; ELISA: enzyme-linked immunosorbent assay; GSH: glutathione; GSHPX: glutathione peroxidase; HDL: high-density lipoprotein; LDL: low-density lipoprotein; LH: lipid hydroperoxide; MBH: membrane-bound haemoglobin; MDA: malondialdehyde; SOD: superoxide dismutase; TBARS: thiobarbituric acid reactive substances

Notes: Benzene: a toxic industrial solvent. MDA and 4-HNE are products of lipid peroxidation. MDA-LDL is an oxidised type of LDL. Oxidised LDL promotes the build up and progression of plaques. MBH and band 3 profile are markers of erythrocyte damage or ageing. TBARS: common assay to measure lipid peroxidation, but not specific – reliable for defined membranes but unreliable for body fluids and tissues. 8-OHdG is a marker of DNA oxidation.

Trial Details	Dosage & Duration	Results	Ref
Grape Seed extract			
controlled, Brazil; healthy volunteers	grape seed extract (85 mg/day of OPCs) for 8 weeks	Plasma MDA, total hydroxyperoxides and protein carbonyl groups significantly reduced by 34.0%, 34.0% and 14.3% respectively from baseline values. Blood SOD was unchanged.	27
uncontrolled, Italy; healthy volunteers	grape seed extract (110 mg/day of OPCs) for 30 days	Results suggest that DNA oxidative damage was reduced and liposoluble vitamin E was spared: • alpha-tocopherol in red blood cell membranes increased, • lymphocyte oxidised DNA was reduced, • red blood cell membrane fatty acid composition shifted to a higher level of polyunsaturated fatty acids.	28
controlled, United States; metabolic syndrome	grape seed extract (141 mg/day of OPCs) for 4 weeks	Decreased levels of plasma oxidised LDL (ELISA), but not significant compared to placebo. The change in oxidised LDL appeared to be inversely related to the baseline concentration.	29
controlled, Japan; volunteers with LDL-cholesterol levels of 100-180 mg/dL (2.56-4.61 mmol/L)	grape seed extract (200 mg/day of OPCs) for 12 weeks	Plasma MDA-modified LDL significantly reduced from baseline values. Blood lipids were significantly altered compared to baseline, but were not different from placebo.	30
Green Tea			
controlled, Portugal; healthy volunteers	green tea beverage (1.75 g/day of dried leaf, consistently prepared: same temperature, time of infusion and concentration) for 4 weeks	An antioxidant effect was observed (results were compared to consumption of water): • significant reduction in serum levels of MDA and MDA+4-HNE, • significant reduction in the oxidative stress within erythrocytes (lower value of MBH, increase in the band 3 monomer (change in band 3 profile towards normal)), • increase in total antioxidant status in 85% of individuals.	31
controlled, Japan; healthy volunteers	green tea beverage (4.5 g/day of dried leaf) for 2 weeks	Decreased susceptibility of plasma and LDL to oxidation (using lag time of conjugated diene formation). SOD activity in plasma and serum TBARS remained unchanged.	32
controlled, Libya; benzene-exposed workers and healthy volunteers	green tea beverage (6 cups/day, each cup: 0.5 g dried leaf/150 mL) for 6 months	Drinking green tea during exposure to benzene reduced several parameters indicative of oxidative stress. Green tea: • reduced the elevated urinary levels of benzene and two of its metabolites, • nearly reversed to control levels the reduction in plasma GSH and erythrocyte antioxidant enzyme activity, • alleviated but did not reverse to control levels the increased plasma MDA and reduced total antioxidant activity. In controls (healthy volunteers without occupational exposure) green tea consumption increased GSHPX and catalase activities.	33
crossover, controlled, Brazil; weight-trained men whose diet was low in vitamin E and carotenoids	green tea beverage (600 mL/day, 10 mg dried leaf/mL i.e. 6 g/day of dried leaf) for 7 days	Green tea significantly reduced plasma LH just before and at 15 minutes after exercise (bench press session). Other antioxidant effects observed: • increased GSH and antioxidant capacity, • inhibited the exercise-induced rise in creatine kinase and xanthine oxidase, • decreased AST activity and hypoxanthine and uric acid concentrations before and after exercise.	34
crossover, controlled, Spain; healthy volunteers	green tea extract (containing 375 mg/day of catechins) for 5 weeks	Consumption of green tea extract was associated with a 37.4% reduction in the concentration of oxidised LDL (TBARS), and a decrease in the levels of antioxidised LDL IgM antibodies. Results were significant compared to placebo.	35
two uncontrolled, South Korea; healthy volunteers and smokers	green tea beverage (600 mL/day, made from 5.2 g/day of dried leaf) for 4 weeks	Plasma oxidised LDL significantly decreased from baseline values. Total antioxidant capacity (a less specific test) was not changed.	36,37

controlled, Italy; healthy volunteers	green tea extract (containing about 250 mg/day of catechins) for 42 days	Significant increase in plasma total antioxidant activity, significant decreases in plasma peroxide level and induced DNA oxidative damage in lymphocytes, compared to baseline values. Results were significantly different from the control group.	[38]
controlled, USA; heavy smokers	green tea beverage (decaffeinated, 4 cups/day, each cup containing about 73 mg of catechins) for 4 months	After adjusting for confounders (e.g. body mass index, physical activity) urinary 8-OHdG was significantly reduced by 31% from baseline values.	[39]
Turmeric			
uncontrolled, Spain; healthy volunteers	turmeric extract (20 mg/day of curcumin) for 45 days	Serum MDA significantly reduced from baseline values.	[40]
uncontrolled, Europe; healthy volunteers	turmeric extract (20 mg/day of curcumin) for 60 days	Significant reduction in serum peroxides of LDL-cholesterol and HDL-cholesterol from baseline values in those with initially high levels.	[41]

Table 1. Clinical studies of antioxidant activity for selected doses of Grape Seed extract, Green Tea and Turmeric. In the case of Green Tea, trials published after 2000 are presented. Single-dose trials are excluded.

Blood Pressure

A small, randomised trial found that treatment with Grape Seed extract (141 mg/day of OPCs) for 4 weeks resulted in a significant **decrease in blood pressure** in volunteers with metabolic syndrome. Systolic blood pressure decreased from 134 mmHg to 123 mmHg and diastolic decreased from 83 mmHg to 77 mmHg. Similar decreases were observed for those receiving twice this dosage (i.e. no additional effect found for the higher dosage). No change was observed in those receiving placebo. Grape Seed extract, at either dosage, did not have a significant effect on serum lipids or fasting blood glucose.[29]

Bowel Flora

In healthy adults, faecal odour and the concentration of methyl mercaptan gas from faeces decreased significantly after 2 weeks' administration of Grape Seed extract (190 mg/day of OPCs). After a washout period, volunteers took Green Tea extract (providing 250 mg/day of catechins). The effect on these parameters was greater for Grape Seed extract than for Green Tea extract. In addition, compared to baseline, the number of **Bifidobacterium increased** significantly, the number of Enterobacteriaceae and putrefactive substances (such as ammonia, skatol) tended to decrease after 2 weeks of Grape Seed extract.[42]

Green Tea

Green Tea is the unprocessed, dried, young leaves of *Camellia sinensis*.

In addition to its extensive consumption as a beverage, Green Tea has been used medicinally. The Chinese regarded it as having a beneficial effect on the body, as written in an ancient text "... it clears the voice, gives brilliancy to the eye, invigorates the constitution, improves the mental faculties, opens up the avenues of the body, promotes digestion, removes flatulence, and regulates the body temperature".[43] Indications in traditional Chinese medicine include dizziness, restlessness, indigestion and dysentery.[44]

The main active constituents of Green Tea are polyphenols (also called catechins): epicatechin, epigallocatechin, epicatechin-3-gallate and epigallocatechin gallate (EGCG). EGCG is the major catechin in Green Tea.[45] The catechins are absorbed rapidly after ingestion of Green Tea.[46]

It is difficult to relate the epidemiological information on Green Tea to a dried leaf or catechin dosage. The catechin content of a cup of tea varies according to leaf quality, manufacture and tea preparation. In addition to the quality of the leaf, composition of the infusion is influenced by whether the tea is contained in a teabag (and the size, shape and material of the bag), ratio of leaf to water, infusion time and amount of agitation. In China and Japan, Green Tea is normally prepared by infusing it in hot, but not boiling water. Generally the first infusion is discarded (to avoid bitterness) and it is the second and subsequent infusions that are consumed.[47] It is also reported that the third cup of brewed tea has substantially decreased levels of EGCG compared to the first two cups.[48]

The chemopreventive activity of Green Tea is likely to be due to multiple mechanisms, most importantly: inhibition of the pathways essential for the development of tumours; enhancement of apoptosis of premalignant or malignant cells (leading to cell death).[49] Induction of phase II enzymes may also be involved.[50]

Clinical Studies

Antioxidant Activity

Conflicting results have been reported for the antioxidant activity of Green Tea in clinical studies. The results may have been confounded by how the tea was prepared (e.g. brewing time, concentration) and other dietary and lifestyle factors.[31] A review of trials to 2000 found that antioxidant activity has been demonstrated, although a strong conclusion could not be drawn. Further evidence using suitable biomarkers is recommended. Extract, catechins as well as beverage (in the range of 1–6 cups/day) were administered. Many of the trials used a single dose and tests of low specificity.[51] *Refer to Table 1*

for antioxidant activity of Green Tea beverage and extract in trials published after 2000.

Cardiovascular Health

A systematic review assessed randomised controlled trials and found that Green Tea **reduced LDL-cholesterol** by 0.23 mmol/L (8.8 mg/dL). Two to five cups per day would be required to achieve this.[52] A large epidemiological study found consumption of Green Tea was associated with lower serum concentration of total cholesterol (0.015 mmol/L (0.6 mg/dL) for each cup consumed, the effect levelling off at more than 10 cups/day),[53] although studies of more rigorous analysis (capturing more dietary confounders) are required.

Meta-analysis of nine epidemiological studies indicates individuals consuming 3 or more cups of green or black tea per day had a 21% **lower risk of stroke** than those consuming less than one cup/day.[54]

Other epidemiological studies have also shown Green Tea consumption:

- is associated with **reduced mortality** due to all causes and due to cardiovascular disease, but not with reduced mortality due to cancer; results from the largest cohort study to date, were strongest for consumption of 5 or more cups (100 mL/cup) per day, and for women;[55]
- may be associated with **reduced risk for subarachnoid haemorrhage**; strongest results for drinking Green Tea one or more times per day;[56]
- is inversely associated with angiographically proved coronary artery disease (CAD) in 2 studies,[57,58] but protective effects not found in another study;[59] a more recent study found **reduced risk of CAD** in male patients (for consumption of more than 125 g/month of dried leaf) but not female patients;[60]
- is inversely associated with **myocardial infarction** (one or more cups/day);[59]
- **reduced risk of developing hypertension** (120 mL/day or more for one year).[61]

In controlled trials, Green Tea beverage (600 mL/day, made from 5.2 g/day of dried leaf) for 4 weeks **improved atherosclerosis markers**: soluble P-selectin in smokers and soluble vascular cell adhesion molecule-1 in healthy volunteers. Lipid profiles were unchanged.[36,37]

Chemoprevention & Antimutagenic Activity

A meta-analysis assessed the association between Green Tea consumption and the risk of cancer incidence and mortality. Fifty-one studies up to January 2009 with more than 1.6 million participants were included: 27 case-control studies, 23 cohort studies and one randomised controlled trial. Although insufficient evidence was found to make a recommendation, desirable Green Tea intake is 3 to 5 cups per day (up to 1200 mL/day), providing a minimum of 250 mg/day catechins.[62]

- The evidence suggests Green Tea may **reduce the incidence of liver cancer**, **ovarian cancer**, **prostate cancer** and **oral cancer**. In addition to epidemiological data, the analysis for prostate cancer risk included a randomised controlled trial which used a dosage of 600 mg/day of Green Tea catechins.
- The evidence is contradictory for the effect of Green Tea on the incidence of cancers of the digestive tract (other than of the liver) and breast cancer.
- Consumption of Green Tea does not prevent lung or bladder cancer, and does not decrease the risk of dying from gastric, lung, pancreatic or colorectal cancer.

Green Tea consumption was associated with a lower risk of haematological malignancies: 42% lower risk in those drinking 5 or more cups/day compared with less than one cup/day.[63] A small case-control study found that compared to non-drinkers, the risk of adult **leukaemia** declined with increasing quantity, duration and frequency of Green Tea consumption.[64]

Consumption of Green Tea was associated with **reduced DNA damage** in smokers. The activity was measured by the frequencies of micronuclei and sister-chromatid exchange in lymphocytes.[65,66] In these studies, smokers were drinking 2-3 cups/day for 6 months,[66] or beverage containing more than 2 g/day of dried leaf.[65]

Cognitive Function, Mental Health

A Japanese epidemiological study found consumption of about one cup/day of Green Tea **reduced the risk of cognitive impairment** in the elderly by 38%, compared to those who drank three or less cups/week. Two or more cups/day reduced the risk by 54%.[67] This larger study, which utilised the Mini-Mental State Examination test, strengthens the earlier, preliminary research.[68-70]

Compared to those drinking one or fewer cups per day of Green Tea, the risk of having mild or severe **depressive symptoms** was 44% lower in elderly Japanese individuals drinking 4 or more cups/day.[71] In a large, epidemiological study, Green Tea consumption was inversely associated with nonspecific, **psychological distress**. Prevalence of distress was highest (8.4%) among those who consumed less than one cup/day, and lowest (5.1%) among those drinking 5 or more cups/day.[72]

Bowel Flora

A small clinical study demonstrated a Green Tea catechin preparation **increased levels of lactobacilli and bifidobacteria**, lowered levels of Enterobacteriaceae, Bacteroidaceae, and eubacteria, and decreased odorous compounds in nursing home patients. Levels of pathogenic

bacterial metabolites were also decreased.[73,74] A further study found that supplementation with tea catechins reduced faecal moisture, pH, ammonia, sulphide and oxidation-reduction potential.[75] In both trials the dosage was 300 mg/day of catechins.

Turmeric

Turmeric has been used widely in Asia as a food and traditional medicine. Some of the traditional indications in India, China and Thailand include: liver disorders, mass formation in the abdomen, traumatic swellings and for health promotion.[76-78] *In Ayurveda, Turmeric is a blood purifier, and has been used both internally and externally for skin diseases.*[79] In Europe, Turmeric has been used for dyspeptic complaints and digestive disorders of hepatic origin.[80] A contemporary Ayurvedic text recommends Turmeric to strengthen digestion and help improve intestinal flora.[81]

The main constituents of *Curcuma longa* rhizome are the yellow pigments (curcumin and methoxylated curcumins) and an essential oil containing sesquiterpenes.[82]

The chemopreventive effects of curcumin have been extensively studied in experimental models. It is beneficial at the three stages of cancer: initiation, progression and promotion. Much of the beneficial effect is due to its inhibition of the transcription factor nuclear factor kappa B (NF-kappaB) and subsequent inhibition of proinflammatory pathways.[83] Oral doses of curcumin and Green Tea catechins had a synergistic colon chemopreventive effect in an experimental model.[84] The synergistic effect of these compounds may be due to inhibition of cancer cell growth by different mechanisms.[85]

The ability of curcumin to induce phase II enzymes also plays a part in the prevention of tumours.[83] In experimental models, oral doses of Turmeric and curcumin enhanced the activity of phase II enzymes, such as glutathione S-transferase, particularly in the liver.[86,87]

Clinical Studies

Antioxidant Activity

Refer to Table 1 for antioxidant activity of Turmeric in healthy volunteers.

Cardiovascular Health

Administration of Turmeric extract (containing 20 mg/day of curcumin) for 30 days decreased serum low-density lipoprotein (LDL) cholesterol and the apolipoprotein B/apolipoprotein A ratio, and increased high-density lipoprotein cholesterol. The results were significantly changed from baseline values. (This ratio of apolipoproteins is a predictor of **atherosclerosis risk**.) Twelve men with high baseline levels of LDL-cholesterol (over 150 mg/dL (3.8 mmol/L)) were assessed.[88] Administration of the same extract at the same dosage for 15 days significantly decreased plasma fibrinogen levels in 8 volunteers who had abnormally high baseline values (over 350 mg/dL).[89] Two months of treatment with curcumin (45 mg/day) tended to improve serum total cholesterol, LDL-cholesterol and HDL-cholesterol levels in patients with acute coronary syndrome (acute myocardial ischaemia). The results were not statistically significant compared to changes that occurred in the placebo group. The effect was diminished, and some parameters were worsened, at higher doses of curcumin (90 and 180 mg/day).[90]

Antimutagenic Activity & Chemoprevention

Turmeric (1.5 g/day) administered for 30 days to 16 chronic smokers significantly **reduced the urinary excretion of mutagens**.[91] Studies on humans at high risk of palatal cancer due to reverse smoking demonstrated that turmeric (1 g/day) for 9 months had a significant impact on the regression of precancerous lesions. The treatment also decreased micronuclei and DNA adducts in oral epithelial cells.[92] (Reverse smoking is a practice where the burning end of the cigarette is kept in the mouth and causes a high incidence of oropharyngeal carcinoma.)

Clinical trials in patients with precancerous lesions have yielded conflicting results (curcumin: doses greater than 500 mg/day;[93,94] Turmeric: 3 g/day of concentrated extract, dried herb equivalent unknown).[95]

Maintaining Cognitive Function

A cohort study in Singapore found a possible association between consumption of Turmeric-rich curry and **better cognitive performance** in nondemented elderly Asians. Those who consumed curry occasionally and often/very often had significantly better Mini-Mental State Examination scores than did citizens who never or rarely consumed curry.[96]

Rosemary

In addition to the main indications of flatulent dyspepsia, depression, headache,[97] Rosemary is well regarded in European herbal medicine for dyspeptic conditions, improvement of hepatic and biliary function and as a tonic for the circulatory system.[98-100]

Rosmarinus officinalis leaf contains essential oil, phenolic diterpenes (including carnosol and rosmarinic acid), flavonoids and triterpenoids.[82]

Rosemary is a strong antioxidant used in the food industry as a preservative, particularly for meat products.[101] The antioxidant activity is attributed to the diterpenes, particularly carnosol and carnosic acid.[102] Interestingly Rosemary has a strong *in vitro* antioxidant activity in

saturated fats[103] which is unusual as most antioxidant plant extracts and phytochemicals demonstrate activity in aqueous systems.

Antioxidant activity by oral doses of extract of Rosemary (whole plant) has been demonstrated *in vivo* by a reduction in lipid peroxidation.[104]

Experimental studies have indicated Rosemary leaf also has hepatoprotective activity (possibly due to antioxidant activity and improvement of phase II enzymes such as glutathione S-transferase)[105-107] and has reduced the development of mammary carcinoma.[108]

Oral administration of Rosemary extracts induced some phase I enzymes and phase II enzymes in several *in vivo* studies.[109-111] Rosemary extract had greater activity than isolated constituents administered by the same route.[109,110]

Synergistic Formulation

These herbs would complement each other in a potent formulation with the following actions:

- antioxidant,
- cancer preventive,
- supports liver detoxification, particularly via phase II enzyme activity,
- vascular protective, venotonic, connective tissue supporting,
- anti-inflammatory.

Indications

- Protection against oxidative stress, such as that generated by exercise.
- May help prevent the onset of chronic diseases and diseases associated with ageing, especially cardiovascular disease.
- Prevention of cancer, and recurrence in cancer patients.
- Poor liver function, liver diseases; support detoxification, particularly by enhancing phase II enzymes.
- Support healthy cognitive function.
- May help improve unhealthy lipid profiles.
- To help balance bowel flora.
- Lowered capillary resistance (including in diabetes and hypertension), venous insufficiency, varicose veins, haemorrhoids, oedema, retinopathy.
- Skin disorders; promote healthy skin.

Cautions and Contraindications

Although Green Tea contains less caffeine than coffee, the caffeine content should be taken into consideration if high doses of Green Tea are prescribed.

A number of cases from 2001 were reported that suggested an association of Green Tea with liver damage. Almost all cases involved extracts made from ethanol. Green Tea should therefore be ingested as a beverage or extract made from water.

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